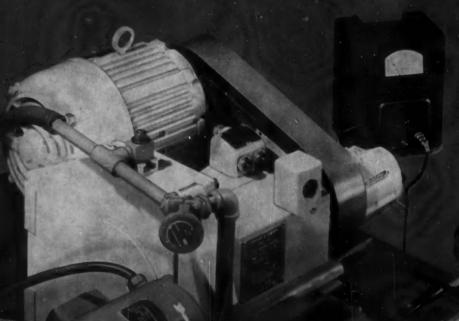
ENGINEERING AND PRODUCTION IN METALWORKING

MAY 1960

Machinery



Brown & Sharpe No. 5 Plain **Grinding Machine** See Page 16

to help you make more for less







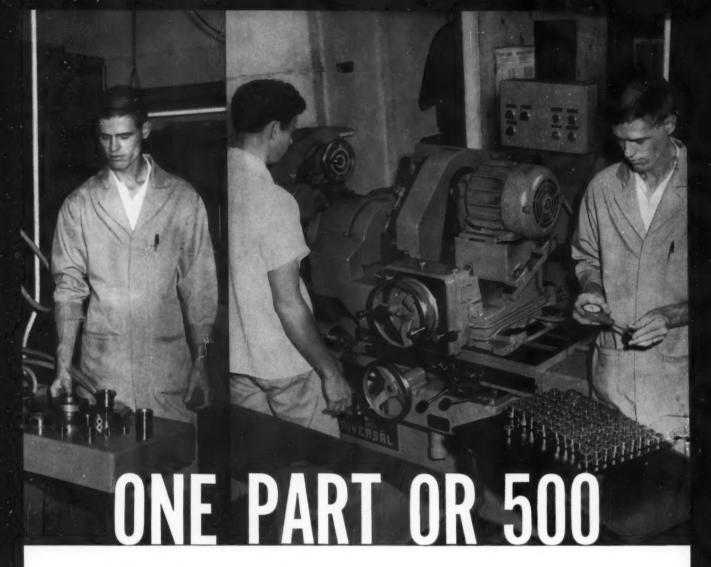








Brown & Sharpe PRECISION CENTER



Selco gets top grinding performance at rock-bottom cost with the

NEW HEALD MODEL 273A UNIVERSAL

The Heald Model 273A Universal Internal Grinder shown above is installed at the Selco Grinding Company — a small but busy job shop in southern California. Here it is used to grind straight or tapered I.D.s and O.D.s, and for rotary surface grinding of flat, convex or concave surfaces of a wide range of work — from individual parts to production runs. And it easily handles every job with far greater speed, accuracy, precision and finer finish than could be obtained on any of their previous equipment.

Until the advent of this Universal Grinder, most small job shops (and many larger ones, too) couldn't afford a machine of this type. But the Heald 273A costs about *half* as much as comparable machines today, and less than similar machines (with fewer features) cost in 1947!

Incorporating the latest advances in the grinding art, it holds tolerances to within .0001" in routine production, and within .000050" in special cases. Features include hydrostatic antifriction ways, full 20" table travel, several wheelhead positions, infinitely variable workhead speed from 150 to 450 rpm and 90 degree workhead swivel for rotary surface grinding.

Ask your Heald engineer for information on the New 273A — the only completely new machine with 1960 performance and a 1947 price tag.

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts



It PAYS To Come To Heald

MAY 1960 VOL 66 No. 9

Editors

CHARLES O. HERB

Associate Editors:

FREEMAN C. DUSTON
EDGAR ALTHOLZ
RAYMOND H. SPIOTTA
HAROLD W. BREDIN
LAURENCE W. COLLINS. Jr.

Materials Editor: PAUL B. SCHUBERT
Shop Mathematics Editor:

HENRY H. RYFFEL

Published monthly by THE INDUSTRIAL PRESS. ROBERT B. LUCHARS, President; EDGAR A. BECKER, Vice-President and Treasurer; HAR-OLD L. GRAY, Secretary and Publishing Markager. Editorial, Advertising and Circulation Offices: 93 Worth St., New York 13, N. Y. Telephone, CAnal 6-8120.

Advertising Representatives

WALTER E. ROBINSON

GORDON BRAUNINGER
93 Worth St., New York 13, N. Y.

ROBERT I LICK

313 E. 216th St., Cleveland 23, Ohio

EMMET J. O'CONNELL

228 N. LaSalle St., Chicago 1, III.

NORMAN O. WYNKOOP, Jr.

44 Highland Ave., Detroit 3, Mich.

DON HARWAY & CO.

1709 W. Eighth St., Los Angeles 17, Calif.

RICHARD E. HOIERMAN

9006 Capri Drive, Dallas 18, Tex. FRED W. SMITH

1201 Forest View Lane, Birmingham 9, Ala.

Subscription rates: United States and Canada, one year, \$10; foreign countries, one year, \$15; two years, \$28. Single copies, \$1.00; foreign, \$1.50. Changes in address must be received by the tenth of the month to be effective for the next issue. Send old as well as new address. Copyright 1960 by THE INDUSTRIAL PRESS.

Accepted as controlled circulation publication at Bristol, Conn.

Great Britain
MACHINERY
National House, West St., Brighton 1, England

France
LA MACHINE MODERNE
15, Rue Bleue, Paris-IX*, France





Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

Fuel Elements for Nuclear Reactors Edgar Altholz	101
Advanced Electronic Systems Need Versatile Metalworking Harold W. Bredin	112
Making Better Pumps Faster Harold W. Bredin	120
"Rubber Tooling" Goes to Work Laurence W. Collins, Jr.	124
Modern Machine Tools Increase Production Efficiency R. B. Stoner	129
Precision Bearing Machining—Automatically	141
Cut and Ground Thread Taps—11 and 12 (Data Sheet)	165

MACHINE AND TOOL DESIGN

Power-Operated Chucks Hold Down Production Costs Harry	y L. Stewart 131	
Gyroscopic Grinding Setup		,
Novel Work-Holder for Lathe Operations	liff Bossmann 138	
Handy Bench Micrometer for Three-Wire Measurements	H. J. Gerber 139	,
Fast-Acting Retractable Locator)
Self-Locking Driver for Parts with Socket Head Alfred H.		,
Magnet-Backed Belt Feed Orients Parts for Riveting	151	
Press Forming Tools Made without Machining	157	,

MANAGEMENT PROBLEMS

Industrial Complacency Charles O. Herb	
Simple Procedures Establish Realistic Tolerances N. L. Enrick	109
1050 Ways to Cut Costs Everett M. Hicks	118
How Will That Meeting Rate? Bernard Lester	156

REFERENCE SECTION

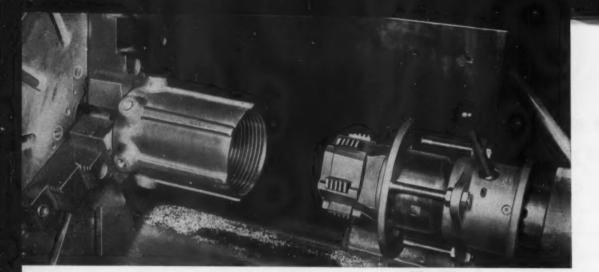
Monsuroment	Errore is	Conr	Poll	Tection		Bishaud I	There	340
weazotement	CHOI2 II	i vear	KOII	resting	************	Richard L	. Thoen	145

DEPARTMENTS

Keeping up with Washington	7 Lat	est Developments in Shop Equipment 160
In Shops Around the Country 1:		a Sheet 165
Ingenious Mechanisms	36 Nev	v Catalogues 188
Tool Engineering Ideas	38 Bet	ween Grinds 198
Problem Clinic 1	53 Nev	ws of the Industry 258
Materials 1	54 Con	ning Events 272
Talking with Sales Managers 1	56 Boo	ok Reviews 274

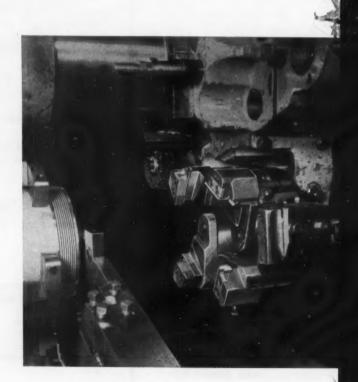
ADVERTISERS' INDEX 285





the world's largest selection of thread





requires the selection of the proper Thread Cutting Tool for the job to be done, and is the essence of LANDIS design. To ensure that you may use the most efficient threading tool, LANDIS manufactures the world's largest selection of Thread Cutting Tools both internal and external.

cutting tools

... in a range of $\frac{1}{8}$ "—9 $\frac{1}{4}$ " for thread-

ing machines, turret lathes, screw machines, reversing spindle machines, bar automatics. Heat-Treated types for economy, wide range coverage, quick set-up changes and oversize capacity. Hardened and Ground types for work on which extreme accuracy and maximum production are of prime importance. Solid Adjustable types for high production threading on reversing spindle machines.

parallel threads, Receding Chaser Collapsible Taps for tapered threads. Both have wide diametrical range through use of detachable heads. Non-Collapsing Solid Adjustable

diametrical range through use of detachable heads. Non-Collapsing Solid Adjustable types for high production tapping on reversible spindle machines. Special Taps are available.

... all Landis Die Heads use Landis Tangen-

tial Chasers featuring: interchangeability, natural cutting clearance, permanent throat, useable for most of their length, right- and left-hand threads with the same chasers, and changeable rake and lead angles. Landis Tap Chasers, manufactured with the same consistency of quality and experience as the Tangential Chaser, are "tailor-made" to suit the application to produce a high degree of thread finish and the maximum number of pieces between grinds.

The constant research for better threading methods which has brought to LANDIS leadership in its field today plays an even more important part in our activities. We offer all manufacturers our over 50 years experience in all phases of Threading. If you need help involving threads, whether design or production, or if you feel that your present threading methods should be improved, send us your specifications, or our representative will call at your convenience on request.

LANDIS Machine COMPANY

PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT



553C



Threating Machine



Die Heeds -



Tape -- Collapsible & Solid Adjustable



Centerless Throad Crinding Machines



Thread Rolling Tools



Thread Rolling Machines

for Every Gear Production

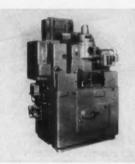
Job

Right from the blank to the finished external or internal spur or helical gear, Fellows has the complete line of gear production and inspection equipment to meet all your requirements!

No other builder in the world offers as long and varied a line: Fellows Gear Shapers; Pfauter Gear Hobbers: Fellows-Reishauer Gear Grinding Machines: Fellows Gear Inspection Instruments; Fellows special machines and attachments; Fellows Gear Shaper Cutters. All this, plus the benefit of our sixty years of specialized experience in solving gear production problems.

Ask your Fellows representative for information on the complete line of Fellows gear production and inspection equipment. If you have a problem requiring special equipment, ask him to help you solve it, or write direct.

Fellows Has the Equipment to Shape, Hob, Grind and Inspect



Fellows Gear Shapers cut internal and external spurs and helicals; capacities to 120" P.D.



Pfauter Gear Hobbing Machines for spur and helical gears; capacities to 120" P.D.



12 Fellows-Reishauer Gear Grinding Machines grind spurs and helicals to 12" O.D.



No. 20M Fellows Red Liners make and record the "composite check" of spur and helical gears to 18" P.D.

THE FELLOWS GEAR SHAPER COMPANY 78 River Street, Springfield, Vermont

Branch Offices:

1048 North Woodward Ave., Royal Oak, Mich. 150 West Pleasant Ave., Maywood, N. J. 5835 West North Avenue, Chicago 39 6214 West Manchester Ave., Los Angeles 45

THE PRECISION Ellows Gear Production Equipment

Cincinnati

Hy Powermatics

make quick work
of your heavy duty
milling operations



You'll see costs take a big tumble when you assign heavy duty milling jobs to the big CINCINNATI HyPowermatics. These machines have the capacity to remove metal quickly—both hard-to-cut alloys and lighter metals. And they embody a number of convenient features that enable the operator to turn out more work with no increase in effort. Some of the HyPowermatic design highlights are:

- infinitely variable table feed rates, ¼" to 150" per minute
- a wide range of 16 spindle speeds
- · only three gear contacts in spindle drive
- Hydramech table drive, assuring uniformly smooth cutting action
- built-in backlash eliminator, for conventional and climb milling operations

- automatic spindle stop, an important safety feature
- automatic, two-way table cycles
- · J.I.C. hydraulic and electrical standards
- · Dynapoise vibration damping overarm
- choice of plain, duplex, tracer controlled plain and duplex, rise and fall plain and duplex; 50 sizes in each

In addition to these many standard design features, Cincinnati's unit type construction plan can help you obtain special machine capabilities with low cost investment. Complementary units include close-coupled spindle carriers, vertical and angular spindle heads, and others. Get the complete HyPowermatic story by writing for Catalogs M-1909-3 and M-2028-2.

BUILDERS OF FINE MACHINE TOOLS: KNEE TYPE AND BED TYPE MILLING MACHINES . DIE SINKING MACHINES

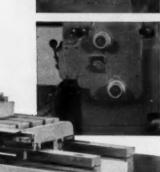
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO



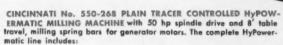
CONVENIENT OPERATING CON-TROLS, all compactly grouped, reduce operator fatigue and increase production.



HARDENED AND GROUND SQUARE GIBBED WAYS and solid well-ribbed bed construction add their share to HyPowermatic's high cutting capacity.



AUTOMATIC QUILL RETRAC-TION extends cutter life, cuts down-time for cutter changes.



No. of Sizes	Types	Table Traverse	Feed hp	Spindle hp
50	Plain	2'-11'	3-5	5-50
50	Duplex	2'-14'	3-5	5-50
50	Plain Rise and Fall	2'-14'	3-5	5-50
50	Duplex Rise and Fall	2'-14'	3-5	5-50
50	Plain Tracer Controlled	2'-14'	3-5	5-50
50	Duplex Tracer Controlled	2'-14'	3-5	5-50

Write for Catalogs: M-1909-3 for 300, 400 and 500 Series HyPowermatics; M-2028-2 for 100 and 200 Series HyPowermatics.



QUICK CHANGE SPINDLE CAR-RIERS are a valuable timesaver when frequent speed changes are necessary because of either short runs or changes in tooling.

AUTOMATIC VARIABLE FEED automatically controls the feed rate during the cut... a definite aid to economical

production.



CUTTER AND TOOL GRINDERS . ELECTRICAL DISCHARGE MACHINES

CINCINNATI

MILLING MACHINE DIVISION

How Microfeed automatically cancels

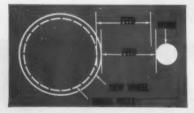


A major problem in cylindrical grinding now solved

Under the pressure for high production, closer tolerances, uniformity and less operator skill, users of precision cylindrical grinders have recently become more concerned with the many variables that affect work size. While these variables have always been accepted as part of the normal operation of a cylindrical grinder, under today's schedules they can be costly liabilities. A close look at some of these variables and their effect on production and precision shows why there is a vital need for Landis Microfeed today.

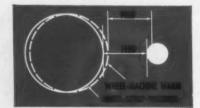
Variables that affect work size

Wheel Wear. In repetitive operations wheel wear is noticeable after grinding a number of pieces. Final size of the work will start to drift to the high limit. To correct this condition, the operator must make a feed com-



pensation by re-adjusting the feed handwheel.

Temperature Variations. A grinding machine will change dimensionally when it absorbs the elevated temperatures of hydraulic oil and coolant. This causes work to be ground undersize. Here again a wheel feed re-adjustment is necessary.



... And These Other Variables:

Repeatability of the forward feed stop position, sparkout variations, wheel loading, variations in wheel grading, variations in material being ground and variations in feed rates due to hydraulic oil changes . . . all these variables affect the tolerances for size, roundness and finish.

These variables lower production because of the time needed by the operator in adjusting the feed handwheel and in gaging workpieces. These variables will lower the efficiency of any grinding operation using an in-process gage.

*Patent Applied For



Landis Microfeed automatically cancels all variables affecting work size

Microfeed was developed by Landis engineers to automatically cancel these variables. Microfeed is an extremely fine feed to final size as indicated by an in-process gage. Microfeed advances the grinding wheel head in increments of 50 millionths of an inch after sparkout. It continues to feed the wheel head until the sizing gage signals finish size.

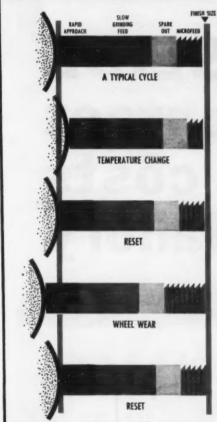
In addition, at the completion of the grinding cycle, Microfeed always resets a pre-determined number of 50 millionth inch reset increments regardless of the number of feed increments required to reach finish size. As Microfeed resets, the other feed elements reset to re-establish the ideal distance from the face of the wheel to finish size for the next cycle. The number of Microfeed reset increments can be varied to suit the condition of the machine, the grinding operation, the material and the wheel. Once set, it will not vary.

Why use Landis Microfeed

- Microfeed will grind workpieces to your closest tolerances . . . automatically.
- It automatically cancels the effect of grinding variables such as wheel wear, changes in machine temperature, wheel action and variations in workpieces.
- Microfeed eliminates the need for manual re-adjustments of the wheel feed handwheel to maintain tolerances.
- It gives uniform size, roundness and finish, at production rates, for maximum efficiency.
- Microfeed is applicable to any production or small lot job that justifies and uses automatic or visual gaging.

all variables affecting work size

Landis Microfeed grinding cycle (a graphic presentation-not to scale)



In the Microfeed cycle there is a rapid approach, slow grinding feed, timed sparkout and Microfeed increments to finish size. (Microfeed uses as few or as many feed increments as are necessary to achieve finish size as indicated by the sizing gage. In this graphic example, there are five Microfeed increments to finish size.)

When the machine is affected by increased temperature, the face of the grinding wheel moves closer to the work centerline—Microfeed (in this case) requires only *three* feed increments to reach final size.

At this point the wheel head retracts to its back position, the other feed elements reset and Microfeed resets a pre-determined amount (five increments in this case) automatically re-establishing the face of the wheel to the original setup position and thus cancelling the effect of the elevated machine temperature.

When wheel wear causes the face of the grinding wheel to be further away from its original position, Microfeed (in this case) requires eight feed increments to reach finish size.

Again the wheel head retracts, the other feed elements reset and Microfeed resets the same pre-determined number of increments "ve) and re-establishes the wheel face to its original setup position. This automatically cancels the effect of wheel wear.



It will pay you to investigate Microfeed before buying new cylindrical grinding machines. Microfeed is available only on new Landis precision cylindrical grinders.

LANDIS
precision grinders

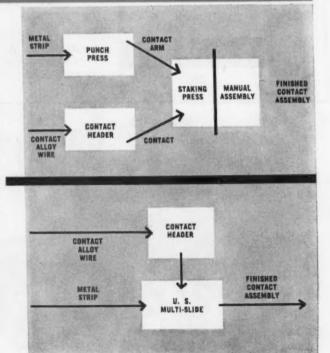
LANDIS TOOL COMPANY WAYNESBORO, PENNSYLVANIA



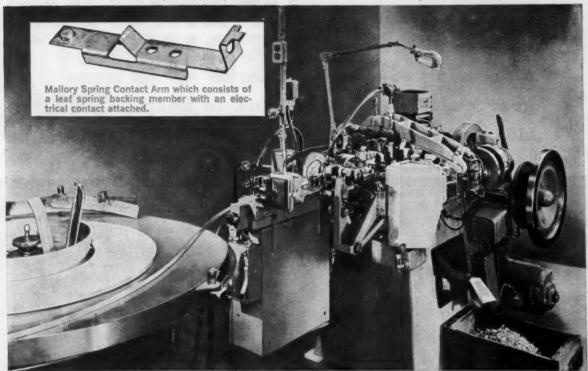
U.S. MULTI-SLIDE cuts contact assembly costs 20% at P. R. Mallory

This shows how a U. S.

Multi-Slide eliminated
a separate staking press
operation. This operation
(now eliminated) required
manual loading which
was slow and costly.
Find out for yourself how
U. S. Multi-Slides can cut
costs, reduce waste and
improve the quality of your
products — write for U. S.
Tool Company Bulletin No. 15M.



U. S. Multi-Slide Model No. 28 with AR-10-48 U. S. Automatic Stock Reel in action at P. R. Mallory & Co., Inc., manufacturers of Electrical and Metallurgical Components, in Indianapolis.



By the use of a U. S. Multi-Slide Model No. 28, P. R. Mallory and Co., Inc. — specialists in complete contact service — entirely eliminated one costly operation in the fabrication and assembly of Spring Contact Arms.





Today, these Contact Arms are formed **and** assembled on a U. S. Multi-Slide. Coil stock for the Contact Arms is fed from a Model AR-10-48 U. S. Automatic Stock Reel. This Multi-Slide pierces, trims, forms and cuts off the spring arms and attaches the prefabricated, hopper fed contacts in one continuous, automatic operation.

In volume production, complete contact assemblies now cost \$3.19 per thousand less — a savings of 20%. And, according to Mallory, this automatic U. S. Multi-Slide production also improved product quality and reduced waste.

U.S. TOOL COMPANY, INC.

AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

General Machine Co. replaces 30year old turret lathe with Warner SEVEN
& Swasey 2AC Single OPERATIONS
Spindle Chucking Automatic to cut manufacturing costs on REDUCED TO
gear cases and covers, and to keep
bids competitive on subcontract work.





Lot sizes range from 100 to 300 pieces on these cast iron gear cases and covers. Note requirement for radial alignment of bushing so that its oil groove and the oil hole in the case will match properly. This is accomplished automatically in station

4 illustrated below.



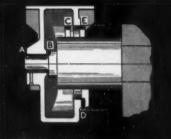
The General Machine Co., Emmaus, Pa., manufactures quality heating equipment sold under the "ELECTRIC FURNACE MAN" name. They also do contract machining, as a regular part of their business, for customers all over the country.

To maintain an acceptable profit margin on their product components as well as keep subcontract bids competitive—much of it on small lot work—General Machine installed a new Warner & Swasey 2 AC Single Spindle Chucking Automatic.

Because of the 2 AC's unique overhead turret design, which houses both turret and spindle bearings in the same temperature zone, problems of spindle rise are eliminated. As a result, General's shop people found they could easily hold single point boring tolerances of .0006 on a day-in-day-out basis.

This repetitive accuracy plus the 2 AC's unique versatility and ease of tooling permitted coal stoker gear cases and covers to be machined complete ready for paint in just two operations—one chucking for each part—including pressing-in and finish boring a bronze bushing. Previously seven operations were required—two machining, two arbor press, assembly of cover to case, line ream and disassembly. Five operations plus considerable part handling were eliminated!

Maybe it's time for you to take a look at your costs with a W/S Field Engineer. Write us. Warner & Swasey Company, Cleveland 3, Ohio.



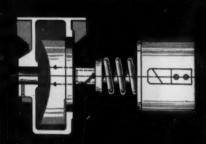
STATION 1. (A) Rough bores (B) Slab faces (C) Rough bores (D) Slab faces (E) Chamfers at 45°.



STATION 3. (A) Finish bores (B) Chamfers at 45°.



STATION 2. (A) Finish bores (B) Finish faces (late rear cross slide pushes turret mounted slide tool after (A) is completed).



STATION 4. Presses bushing. NOTE: Bushing loading tool is picked up and rotates with the lixture as it feeds forward establishing correct radial relation between bushing and gear case.

You can produce it better, faster, for less with a

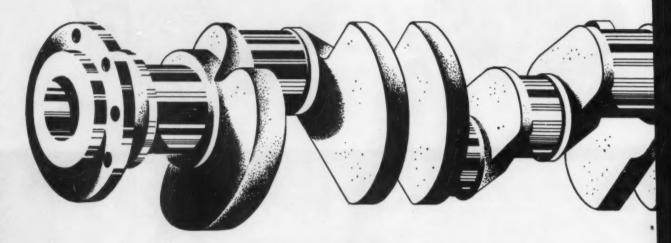
WARNER & SWASEY



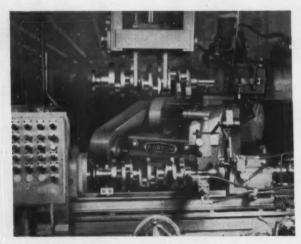


STATION 5. (A) Finish bores the bushing.

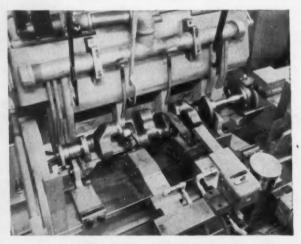
If you grind crankshafts...



check how NORTON grinders can reduce your costs-per-shaft



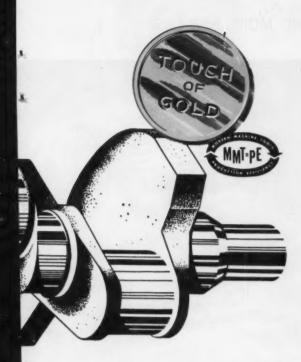
Grinding Gear Fits and shoulders is easily handled on a Norton Type C-V 4 Angular Wheelslide Grinder. By grinding thrust surface and adjacent diameter in a single, automatically controlled plunge grind, the Type C-V 4 provides fastest production with less effort.



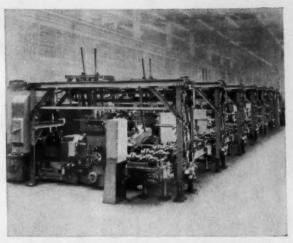
Grinding All Main Bearings At Once is a job for the Norton Type CM-1 Semiautomatic Heavy Duty Multi-Wheel Grinder. Precise finishing of a group of line diameters about as quickly as a single diameter grind assures important cost-savings. Also popular in this multi-wheel application are Type CTU Heavy Duty Cylindrical Grinders.

75 years of . . . Making better products . . .

MORTON PRODUCTS: Abrasives . Grinding Whoels . Machine Tools . Retractories . Electro-Chemicals ... BERR-MANNING DIVISION: Coated Abrasives . Sharpening Stones . Pressure-Sensitive Tapes



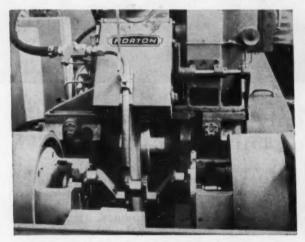
For further facts on how these grinders can benefit you, see your Norton Man, a trained grinding engineer. NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. In Canada: J. H. Ryder Machinery Co., Ltd., Toronto 5.



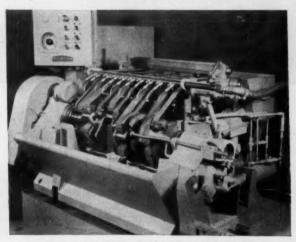
Automatic Grinding of Crankpins on a multi-station basis is handled on the No. 2 Unitized Transfer Type Crankpin Grinder. This machine combines loading, positioning, grinding, gaging, transferring and wheel-truing — a sensational advancement for big volume crankshaft production.



*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



Simplified Grinding of Pins on shafts up to 72" long is the specialty of Norton Type CC-8 CRANK-O-MATIC* Semiautomatic Crankpin Grinders. Automatic cycling under semiautomatic control frees the operator from supplementary operations. Similar advantages for grinding pins on small shafts are provided by Norton Type CTU CRANK-O-MATIC Grinders.



Lapping Pins and Bearings simultaneously in an automatic cycle calls for the Norton No. 31 CRANK-O-LAP® Lapping Machine. Strips of coated abrasive are used as the Lapping medium in producing top-quality finishes. With headstock and footstock carried as a swing frame, manual operation is reduced to easy loading, pushing the "Start Cycle" button and unloading.

to make your products better

MACHINE TOOL DIVISION: Grinding and Lapping Machines - 6 & E DIVISION: Shapers · Gear Cutting Machines · Gear Induction Hardweers



New design No. 5 - the only plain grinder with a 5-year guarantee on a plain bearing spindle

The Brown & Sharpe No. 5 Plain Grinding Machine has remained first choice for production grinding of small parts for good reasons — its accurate repetitive sizing to split tenths, and its long record of cost-saving performance. Now, exclusive new advantages set today's top standards for operating efficiency and economy.

The interchangeable cartridge-type wheel spindle unit needs no adjustment, has self-contained lubrication assures lasting accuracy in the low micro-inch range. The plain bearing unit is unconditionally guaranteed for 5 years. The spindle unit can also be furnished with super-precision, pre-loaded antifriction bearings.

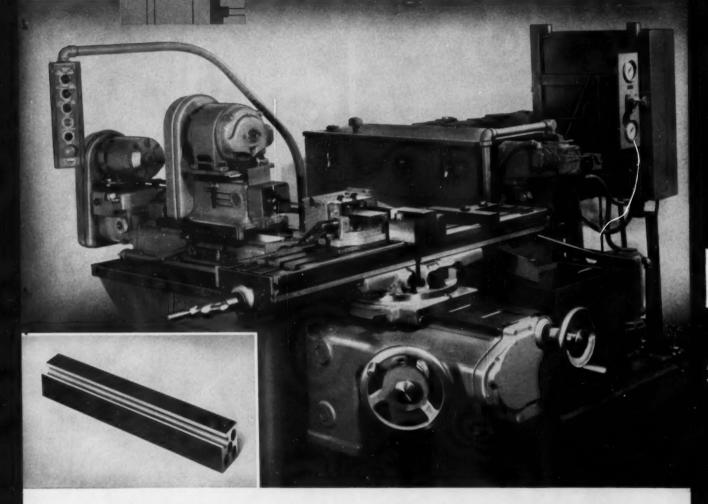
Other design features available only in the new No. 5 include 1) super-smooth Oriflex drive in headstock; 2) "Permalign" footstock that permits fast, easy leveroperated work loading, and maintains accurate alignment; 3) flat swivel table top that is a horizontal working surface, hardened and ground for lasting accuracy.

Before you buy equipment for production grinding in the 1" range, get complete information on all the profit-saving features of the new No. 5. You'll see why it offers you by far the best return on your machine investment. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

Brown & Sharpe PREGISION GENTER



TO HELP YOU REDUCE DEEP HOLE DRILLING COSTS



Saves the extra cost of special positioning fixtures - the new Brown & Sharpe Deep Hole Drilling Machine

Simplified set-ups, tooling economy, and exceptional job adaptability are basic advantages of this new, revolving drill type machine, along with many other features unavailable in conventional equipment used for "gun drilling."

The machine itself provides all directional adjustments needed for fast, accurate positioning of the work piece. Standard vises or other simple clamping devices serve to hold the work for most jobs. You avoid the expense of special, complex positioning fixtures for multiple hole location.

The chip box secured to the column of the machine supports the front drill bushing in accurate alignment with the axis of the drill spindle, maintaining hole surface finish in the low micro-inch range. Positioning controls with the same built-in precision as in Brown & Sharpe Milling Machines assure accurate center location and hole alignment.

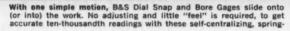
Drilling-head speeds from 2500 to 10,000 rpm, are available as specified. The machine takes drills from 1/8" to 1" dia., and provides up to 12" feed stroke (24" with optional, extra equipment). The high pressure coolant unit (in background) will provide up to 30 gpm of oil and pressures up to 3000 psi.

Find out how the B&S Deep Hole Drilling machine can be adapted to your needs — with special arrangements, when required, such as optical positioning and tape control. For complete information, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

Brown & Sharpe Pregision Genter

TO HELP YOU MAKE PRECISION MEASUREMENTS EASIER AND FASTER...







loaded tools. They spot exact work conditions, such as bell-mouth, out-of-roundness, etc. And by showing how much work is "under" or "over"—they save "borderline" pieces—aid setting of cutting tools.

B & S Dial Snap and Bore Gages tell you faster ...tell you more...in measuring production parts

For precise measurements of outside dimensions and bore diameters — on a production basis — you can't beat Brown & Sharpe Dial Snap and Bore Gages!

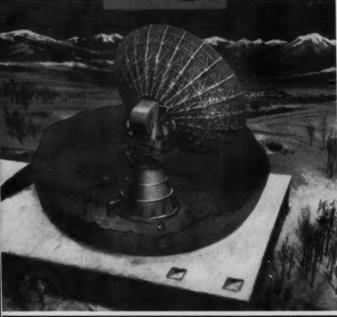
They're faster than micrometer or vernier tools for a series of repetitive measurements — more accurate in unskilled hands. And they "tell more" about the work than fixed or comparator gages because they are direct reading over a complete range.

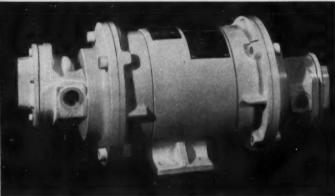
Four B&S Dial Snap Gages cover a range of 0" to 4" by ten-thousandths. Seven B&S Dial Bore Gages cover a range of ½" to 13" by ten-thousandths, with a minimum of interchangeable gaging heads and extensions. Ask your nearby industrial distributor to show you these economical, time-saving tools for precision production measurements. Brown &

Sharpe Mfg. Co., Providence 1, Rhode Island.



TO HELP YOU HANDLE FLUIDS MORE EFFICIENTLY ... AND FOR LESS





This tracking antenna (above) is an important part of the Air Force Ballistic Missile Early Warning System. Goodyear Aircraft Corp. developed it for R. C. A., prime contractor on the system. B&S pumps replenish oil in drive system; control position of drive pump yoke; lubricate entire system.

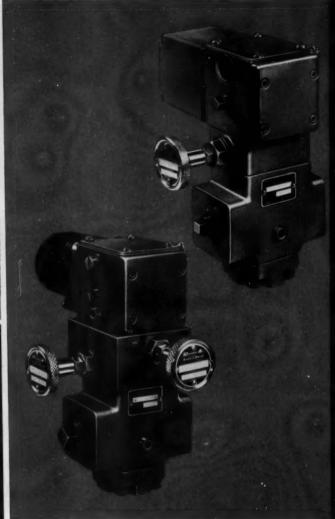
Goodyear designers lubricate BMEWS antenna with B&S Pumps

Designers of this antenna's drive unit needed 4 pairs of pumps, mounted on double-ended motors.

B&S pumps were chosen for their self-priming ability from minus 65°F to plus 160°F; ruggedness and long life.

These and other advantages of Brown & Sharpe gear, vane and centrifugal pumps are clearly described in our new Pump Catalog 36P.

Send for your copy today! Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.



Type "J" adjustable pressure relief valve (above) has attached, sole-noid-controlled pilot valve — provides automatic, full bypass of fluid at idling pressure. Type "D" dual pressure relief valve with solenoid control (below) — provides automatic choice of two, individually-adjustable maximum pressure settings.

Double A develops first multi-purpose relief valves

Here are two more Double A "firsts" in compact valve units: Adjustable relief valves with solenoid controls.

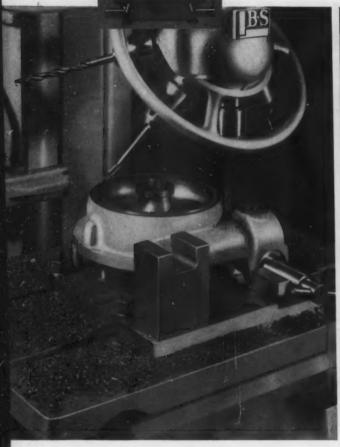
Already successful in machine tools; foundry, steel-mill, mining, material handling and stretch-forming equipment—they can help you simplify your hydraulic circuits, too.

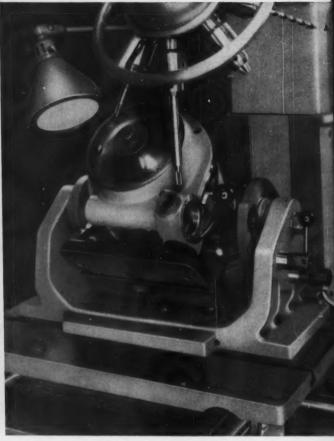
For details on these and the complete line of Double A hydraulic control valves, power units, Gerotor pumps — write: Double A Products Co., subsidiary of Brown & Sharpe Mfg. Co., Manchester, Michigan.

Brown & Sharpe Pregision Genter.

MMT-PE

TURRET DRILLING MACHINES TO HELP YOU DRILL MORE FOR LESS





Large parts machined 300% faster with simple tooling on Brown & Sharpe Turret Drilling Machines



For large as well as small parts, the B&S Turret Drilling technique drastically reduces production drilling costs.

The typical machine casting shown requires machining of 23 holes spaced from 1/2" to 12" apart - drilling, tapping, and counterboring in 4 planes. With simple B&S designed fixtures, mounted on a 101/2" x 12" B&S Positioning Table, accurate hole location (within .001") takes only a few seconds in each sequence. Production time is onethird that required for conventional drilling.

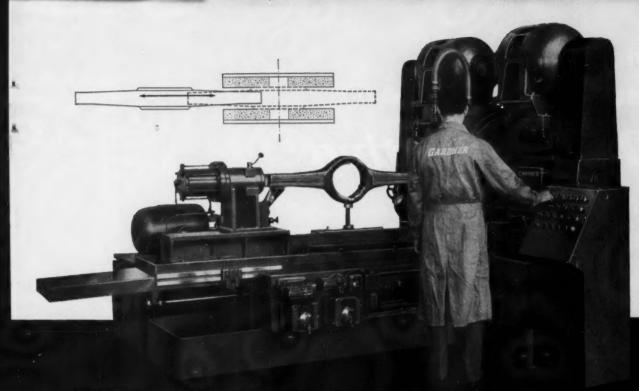
Rapid, accurate positioning methods can be similarly adapted for big savings in production drilling of your larger pieces. On the Model A Turret Drilling Machine shown, you can machine any hole pattern within a 24" circle.

Brown & Sharpe Turret Drilling can save up to 80% of your costs for conventional

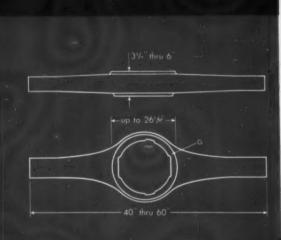
gang-drill, box jig methods. It permits multiple operations at a single station — accurate duplication of any hole pattern without expensive jigs. You save in work transfer and set-up time, in tool wear and maintenance, in capital investment and floor space.

The Brown & Sharpe Tooling Clinic designed the fixtures shown above to take full advantage of turret drilling economy. The work is held as shown (left) in a simple clamping fixture for the first sequence, 24 operations in 8 holes. It is then turned over in the same fixture for 23 operations in 8 holes. The trunnion with index head (right) orients the work for the final sequence, 20 operations in 7 holes, in 3 planes. Send your parts and drawings for a free estimate of savings with turret drilling. Write: Turret Drilling Division, Brown & Sharpe Mfg. Co., Providence, Rhode Island.

Brown & Sharpe Pregision Genter



Disc grinds two sides of large axle housing in one operation



Special fixturing reduces cost over one side at a time grinding

tooling

hydraulic sliding work table air-clamping fixture hydraulic head feed for face cutting automatic lubrication fixture mounted dressers

production data

 Part:
 axle housing

 Operation:
 grinding banjo section

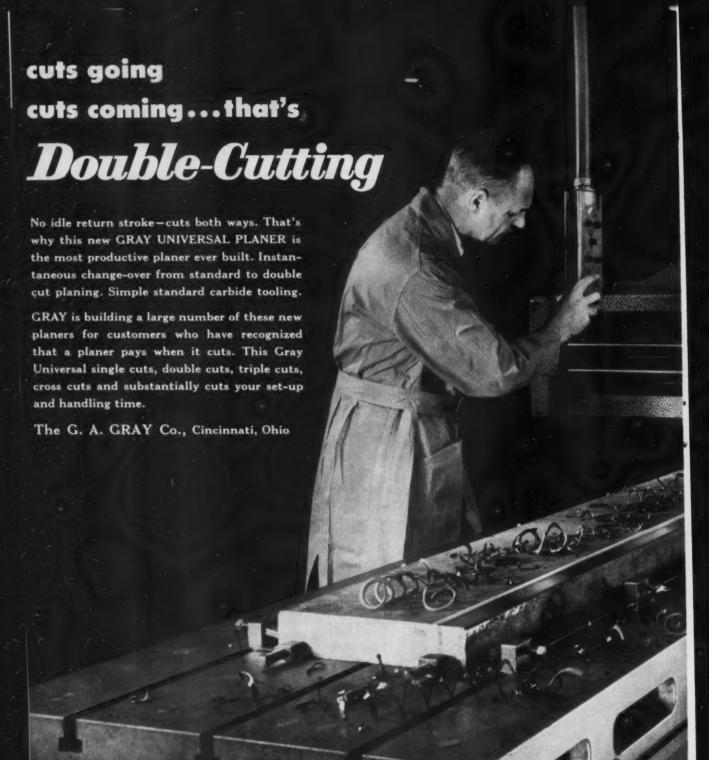
 Rate:
 48 pieces per hour

 Stock Removal:
 ½" to ½"

 Disc Size:
 36" x 3" x 20"

GARDNER

precision disc grinders
BELOIT, WISCONSIN

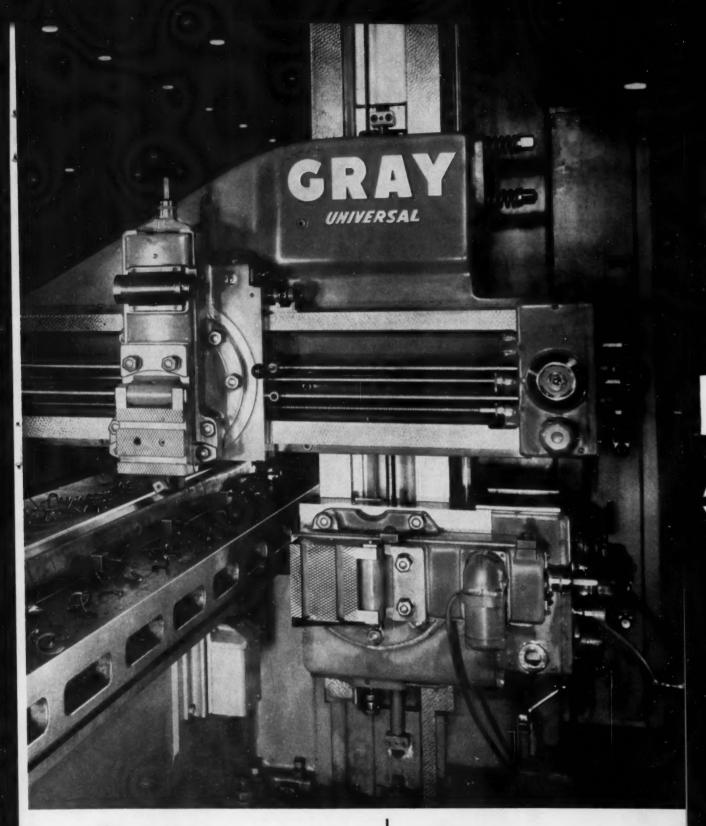


heavy-duty planing

The Gray Universal is the world's most powerful planer available for conventional planing. Its rigidity and speed are ideally suited for modern carbide cutting.

double cut planing

The flick of a lever, the touch of a button permits double cutting. Elimination of the idle stroke insures the world's most efficient flat surface machining. Only simple carbide tools are required.





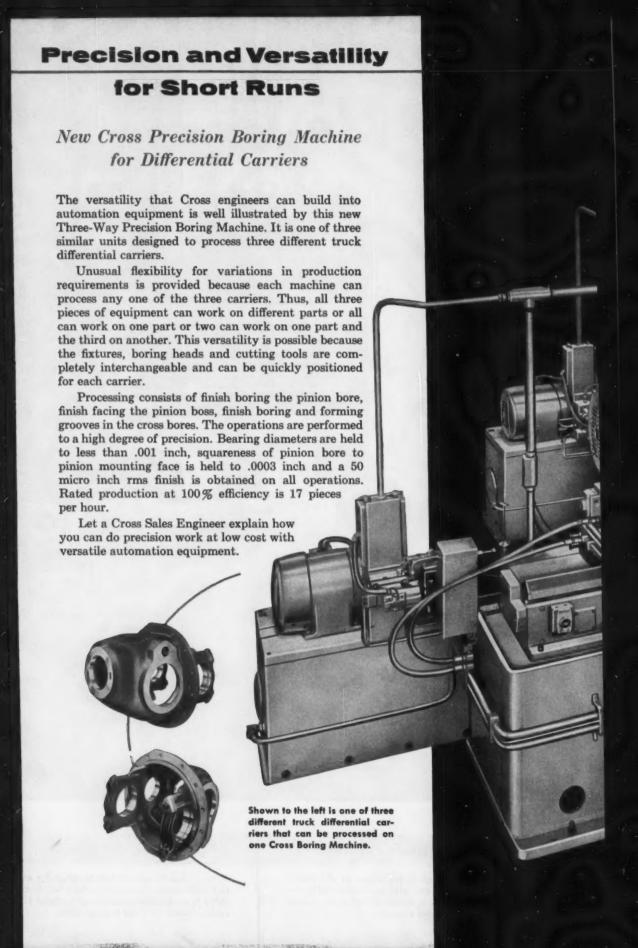
triple cut planing

Rough and rough-finish plane at the same time. Rough by double cut planing and simultaneously rough-finish with a single point tool. Then finish plane without a tool change.



cross planing

Eliminates extra settings by cross planing the occasional keyways, chamfered corners, and other troublesome small cross surfaces that formerly added hours to your set-up time.



Another Automation First by Cross

The work-holding fixture is mounted on a precision index table which rotates 180 degrees for easy loading and unloading.

Fright had 1909

THE

CROSS 127 A

First in Automation

PARK GROVE STATION . DETROIT 5. MICHIGAN



WINTER

accurate and versatile taper pipe taps

WITH BALANCED ACTION

CALL YOUR

WINTER DISTRIBUTOR



UNIFORM FLUTE CONTOURS



ACCURATE AND CONCENTRIC CHAMFERS



EXACT PLUTE SPACING



PRECISION CHIP DRIVER CONTOURS

Winter Brothers Taper Pipe Taps provide famous Balanced Action performance on every internal pipe-threading job. They're long-wearing, high-production tools that reduce your tool inventory costs by keeping replacement requirements at a minimum.

Precision-made Winter Taper Pipe Taps are available from your local Winter Brothers distributor in a complete range of nominal pipe diameters.

Call your Winter Brothers distributor when you want the best in taps and dies for all pipe-threading operations.

WINTER BROTHERS COMPANY

ROCHESTER, MICHIGAN, U.S.A.

Distributors in principal cities. Branches in New York * Detroit * Chicago * Dallas * San Francisco * Los Angeles

CHOOSE FROM WINTER'S WIDE LINE OF TAPS, DIES AND GAGES













side milling cutters and metal slitting saws * tools plus...

Staggered Tooth Side Milling Cutters put National's popular "plus" benefits in your deep slotting operations by giving you longer tool life with less chatter . . . even at higher speeds and heavier feeds!

National's Metal Slitting Saws with side chip clearance are specially designed for deep, narrow slotting, as well as sinking in cuts. Adequate chip space is provided, thus preventing binding and scoring of the work piece.

You can expect reduced metal cutting costs when you specify National . . . the tools "plus". Call your local National Distributor today; he's tops in service, too.

NATIONAL TWIST DRILL & TOOL COMPANY

ROCHESTER, MICHIGAN, U.S.A.

Distributors in principal cities. Branches in New York • Detroit • Chicago • Dallas • San Francisco • Los Angeles



TWIST DRILLS • REAMERS
COUNTERBORES • END MILLS
MILLING CUTTERS • HOBS
CARBIDE AND SPECIAL TOOLS

CALL YOUR NATIONAL DISTRIBUTOR

* JUST TWO OF NATIONAL'S PARADE OF PLUS PRODUCTS

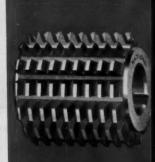




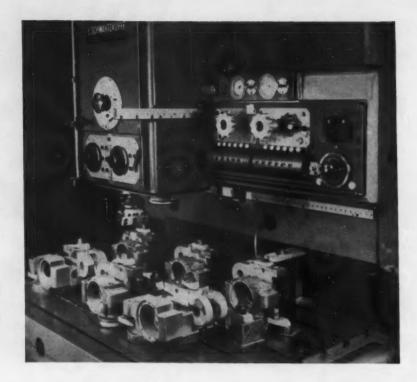








Stainless Steel Atomic Grid
Plates 6 feet in diameter and
10 inches thick—as well as
small, high precision Gear
Boxes shown in the righthand picture—can be bored
and milled equally advantageously on the



SCHWARTZKOPFF



NUMERICALLY CONTROLLED PRECISION BORING AND MILLING MACHINE-KBF2

Other Features:

Capacity: 50" long

30" wide

48" high

Pre-selector for feeds and speeds.

Push-button control throughout.

Rapid power traverse of spindle up and down.

Power tool lock.

Hand positioning for small lots possible.

Lead time practically nil at practically NO COST.

For full particulars write or phone

MARAC MACHINERY CORPORATION

108 Grand Street White Plains, New York Telephone: WH6-0920

MACHINERY, May, 1960

HOW MODIFIED H-P-M STANDARDS TRIPLE
THE USEFULNESS OF METALWORKING PRESSES

TOO CUSTOM

But Just Right For The Job

The sketch at left emanated from the proposal engineering department at H-P-M and a few months later the press, shown in the small photo below, became a reality. It was designed for a combination of hot forging and cold extrusion and incorporated enough unusual press requirements to qualify as special. This 1000-ton H-P-M has a bed area of 66" x 60", 98" of daylight and a 60" stroke. It is equipped with a 150-ton hydraulic ejector cylinder with a 24" stroke. The main ram travels at a speed of 1000 ipm for closing and return with a pressing speed of 600 ipm. The accumulator system shown at right supplies a high speed pressure stroke of 19" in length.

Completely special as normal requirements go but a pressure processing problem that's a typical standard for H-P-M engineers. Both the engineering ability and the facilities to manufacture such huge equipment make H-P-M your best source for metalworking machines of the future.

You're under no obligation to investigate the service that H-P-M has been performing for years — special hydraulic design for the metalworking industry. Write or call for complete details.

The design sketch illustrated is a perspective illustration that accompanies each H-P-M proposal for special machine recommendations. These portfolios contain complete job recommendations, layout drawings, press specifications, delivery and price. It's a service that is backed by thousands of engineering hours from our experienced staff of hydraulic specialists.

THE HYDRAULIC PRESS MANUFACTURING COMPANY

A Division of Koehring Company . Mount Gilead, Ohio, U.S.A.



Throw those shioned collets away!

Now you can afford to equip your

DELTA SOUTH BEND Logan

lathes with the world's most modern
collet chuck and its Rubber-Flex® Collets

\$7000

Model 50 Collet Chuck \$6500

Complete Set of 10 Rubber-Flex Collets

You get a lot more for less!

model

- is a brand new nose type handwheel chuck
- · is quicker to operate
- · is easier to operate
- is more accurate
- · develops more torque
- · increases lathe capacity
- · mounts directly onto your spindle
- costs less . . . less . . . less . . .

A lot more for a lot less...

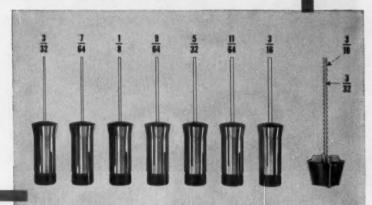
\$**70**00

for the chuck!

\$6500

for the collets!

(\$6.50 each)



An entirely new series of ten Jacobs Rubber-Flex Collets has been developed along with the world's most modern collet chuck. Rubber-Flex collets do more because:

- Jaws are always parallel for greater accuracy . . . maximum runout .001".
- Extra long bearing surfaces have stronger grip.
- Only 10 collets chuck all bar sizes—¾2" to 1½6"—.100" range per collet.

How one Rubber-Flex collet replaces seven split steel collets

This is the chuck, these are the collets, for your...

ATLAS • DELTA • LOGAN SHELDON • SOUTH BEND

... lathes

See your Jacobs industrial supply distributor. Let him prove these fantastic facts with a convincing demonstration at your desk! Call him today.



JACOBS MANUFACTURING COMPANY . WEST HARTFORD, CONNECTICUT



A New Kind of D-c. Motor With DYNAMIC RESPONSE

Here is a motor built to make maximum use of d-c. flexibility. The Super "T" puts Dynamic Response into starts, stops, and speed changes. Dynamic Response gives you a 50% increase in torque and a 50% decrease in reaction time.

This top performance is due to advanced, balanced design. Lighter small diameter armatures cut mechanical inertia 50%. Superior Class B insulation, gives extended life even at temperatures as great as 130°C.

Top grade insulation plus engineered ventilation lets the Super "T" take tremendous overloads. In fact, the Super "T" can develop double normal horsepower during starts, stops, and speed changes.

The Super 'T' is a compact power package, designed inside and out for tough industrial service. From appearance to performance, the Reliance Super 'T' with Dynamic Response is today's most modern industrial motor.

C-1577

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 35A CLEVELAND 17, OHIO Canadian Division: Toronto, Ontario Sales Offices and Distributors in Principal Cities



Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

Another New ARO Air Motor Produces

SUPER POWER

...brings you

SUPER PERFORMANCE in new ARO "2200 Series" TOOLS!



1 For SCREWDRIVING

Forward rotation. Quiet exhaust. Model 7856 illustrated, 2,400 RPM. Adjustable clutch.

2 For DRILLING

Big power in compact size! Quiet exhaust. Model 7846 illustrated, 2,400 RPM.

3 For SANDING

Right-angle sander. Quiet exhaust. Model 7944 illustrated, 3,500 RPM. Polishers also available.

4 For GRINDING

Short grinder, aluminum housing. Quiet exhaust. Model 7872 illustrated, 18,000 RPM.

5 For NUTSETTING

Heavy-Duty, Right-Angle. Direct Drive. Model 7825 illustrated, 800 RPM. Mighty—and eager to prove it! This great new series of ARO super-powered tools gives you more brute power per pound! More speed to slash costs on a wide range of assembly jobs. Greater safety, too—no shock or spark hazard.

Every tool is precision-built, and is more easily adaptable to your specific application. Your ARO Distributor invites you to job-test these new cost-saving tools *now* without obligation!



®AIR TOOLS

Also Art Maris . . . Automation Tools
THE ARO EQUIPMENT CORPORATION
Bryan, Ohio
Are of California, 3141 S. Ersand Are, Los Angeles 7, Calif.
Are Equipment of Canada Ltd., Rendiso (Ceretal), Setaris.
Offices in All Process

33



From one pushbutton station, the line operates as a single unit, but each machining element has its own controls for independent operation.



A "medium" production transfer line like this can be built by adding as little as $12\frac{1}{2}$ per cent to the cost of the individual machines.

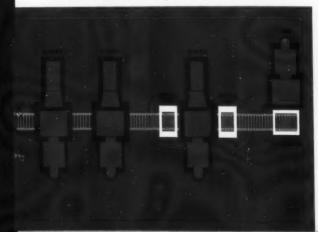
New Convertible Transfer Line Trims Costs of "Medium" Production

By linking four standard Natco multiple-spindle drilling machines with transfer devices, Caterpillar Tractor Co., Peoria, Ill., has substantially reduced the cost of drilling and reaming diesel cylinder blocks. The transfer line incorporates three standard Natco 2-way machines and one vertical C4B.

Each machining unit is self-contained with its own hydraulic and electrical system. Machine units can be interchanged or removed from the line for independent operation. Transfer links are standard Natco types.

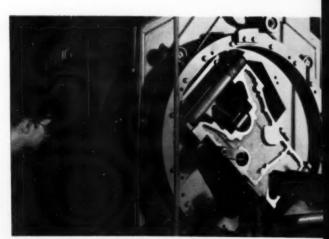
Take advantage of this new approach to "medium" volume production by calling your Natco representative. Write for bulletin No. 100.

Rollover, shuttlebar, and walking beam transfer devices link the various machining units of this unusual line.





The National Automatic Tool Company, Inc., Richmond, Indiana



Rollover device repositions cylinder block. Other Natco transfer devices resolve the loading differences between machining units, providing both in-line and cross-line motion.



one machine does both bar and chucking work...automatically

Here is a ram-type turret lathe "gone automatic." It's the new Gisholt MASTERLINE AR. It handles both bar and chucking work. Changeover takes less than 1 hour. But that's not all. It combines the efficiency and consistent production of an automatic with fast setup and versatility. Yet, the new AR costs very little more than a hand-operated turret lathe!

For long runs or small lots. Whether you are now using automatics for long runs, or standard ram-type turret lathes for small lots, you'll want to evaluate this new development in automatics. You will quickly see how the new AR will cut your costs. Based on productivity, capacity, versatility, dependability, ease of operation, setup speed and original cost,

you'll find it's a new best buy for your equipment dollar today!

Ask for desk-side demonstration. Your Gisholt Representative will gladly explain the costcutting features of the new AR and show you how it can boost profits for you. Ask for your personal, desk-side demonstration or write for literature.



G SMACHINE COMPANY

Madison 10, Wisconsin

Turret Lathes . Automatic Lathes . Balancers . Superfinishers .

Threading Lathes . Factory-Rebuilt Machines with New-Machine Guarantee

Investigate Gisholt's Extended Payment and Leasing Plans



Now...one machine does the work of five!

For small production runs—here's one gearcutting machine with the flexibility of five!

The Gleason No. 118 Hypoid Generator roughs and finishes both gears and pinions—using four cutting methods that formerly required a battery of five machines. When production requirements increase, you simply add other machines, the 118 becoming a specialized member of your production team.

1. Single-Cycle® Method. Using this method, you can cut nongenerated gears four to five times faster than previously possible on machines of this type. Cradle and work head are locked in position. The last rotation of the Single-Cycle Cutter finishes both sides of a tooth space. You cut the mating pinions on the same machine, using the conventional single-roll generating method.

2. Cyclex® Method. For certain applications you can use the extremely fast Cyclex Method on the No. 108 Generator. You cut nongenerated gears in one completing operation from the solid blank.

3. Generated Gears and Pinions. You can produce both gears and pinions on this machine with the generating method. Here, a relative rolling motion takes place between gear or pinion and the rotating cutter. Once the gear is chucked in the work head, the machine operation is entirely automatic.

4. Unitool* Method. If you want to cut small quantities of spiral bevel, Zerol® bevel, or hypoid gears with a minimum of tooling, you can use the Unitool Method. You cut both gears and pinions with a

single cutter. This method is particularly useful for experimental gears for prototype work.

The No. 118 Hypoid Generator handles gears up to 18" diameter at a 10:1 ratio, to a maximum coarseness of 2 DP. For production of smaller gears, the No. 108 Generator cuts gears up to $8\frac{1}{2}$ " diameter at a 10:1 ratio and to 4 DP. A third model, the No. 28 Hypoid Generator, cuts gears up to 33" diameter at a 10:1 ratio, $1\frac{1}{2}$ DP.

For complete information, send for bulletins on all three machines,

Trademark





PRECISION BORING: Control gains a Third Dimension!

Now Fosdick adds <u>Numerical Depth Control</u> to its unique positioning system. Another loophole for error in precision boring has disappeared. Watch the tool drive smoothly to depth, boring a hole with finer finish, precise in depth and location. Watch the tool advance and retract quickly, saving time. *Tape or dial any depth. Absolutely no stops to preset*.

See how this control signals every tool change and compensates for tools of random length. It was planned when the Fosmatic precision boring machines were designed, so that it fits and takes no extra space. Consider what this new dimension in control means to your critical production jobs. Write for catalog PB-W.



THE FUSDICK MACHINE TOOL COMPANY Cincinnati 23, Ohio









POSITIVE DUPLICATION—EVERY TIME!







One animal makes tracks like these, a pattern that is positively duplicated only by the grizzly bear. And only Cincinnati offers you the Positive Duplication of these INTERNAL WHEELS, and of all CINCINNATI ® GRINDING WHEELS.

HOW WE ACHIEVE "PD"

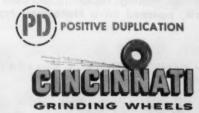
To produce these grinding wheels of unsurpassed uniformity, Cincinnati developed a unique manufacturing process. It involves 36 separate quality controls, from formula blend to final inspection. For example, cams for temperature control of drying ovens must pass regular tests for accuracy, and checking procedures never vary.

HOW UNIFORMITY HELPS YOU

One big advantage of CINCINNATI WHEELS is longer wheel life. Cut the need for frequent wheel changes, and you boost production. Using WHEELS you can plan production schedules with the assurance that each reorder wheel will act and grind exactly like the original. This is the promise—and *performance* of Positive Duplication.

CUT COSTS...CALL CINCINNATI

You can solve your grinding problems with the help of Cincinnati's factory-trained specialists. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI ® GRINDING WHEEL Distributor, or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

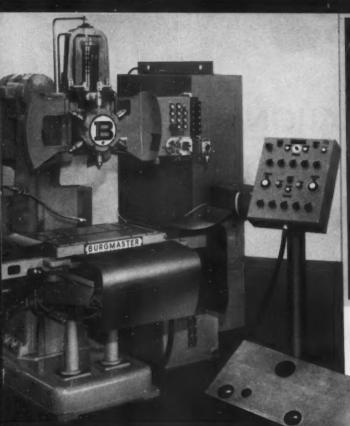


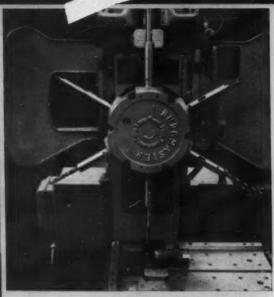
*Trade Mark Reg. U.S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

For more data circle this page number on card at back of book

BURGMASTER tape controlled





This steel drill plate involving drilling 7 holes, c'boring 3 holes, boring and reaming 4 holes was taped in 35 minutes and machined in 31 minutes to tolerances of ±.002". Note the simple set-up.

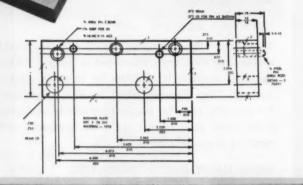
The Machine Tool Exposition
Booth No. 301— Amphitheatre

1960



Simple Tooling, Faster Manufacturing, Lower Costs. Note the simplicity of mounting work on the table for performing a multiplicity of machining operations of ±.002". In a short time approximately 1000 tapes have been made. Tapes are tooling stored for future use — and when parts are repeated — savings snowball.

Note proper method for dimensioning drawing to facilitate tape making. Tapes are standard 1" wide, 8 hole, punched on a Flexowriter typewriter.



World's Largest Builder of Turret Drilling Machines



"O" Manual Power Index W" Canacity



10 Manual Power Index



28 Manual Power Index 36" Capacity



2BR Ram Type Radial Drill %" Capacity



28H Automatic Hydraulic 44" Capacity



38H Automatic Hydraulic



25AH Automatic Tape Controlled 11/4" Capacity



28HT-38HT Automati Tape Controlled

Less Fitting on Small Lots with ...

TURRET DRILLING MACHINE

(at The Ingersoll Milling Machine Co., Rockford, Illinois)

Savings in a number of important indirect ways are made at the Ingersoll Milling Machine Company, Manufacturers of Special Machine Tools, with their Burgmaster Tape Controlled 6 Spindle Turret Drilling, Tapping and Boring Machine. Most of their work comes in single pieces or small lot quantities, which would rarely justify drill jigs or fixtures. Tape Controls are assisting in solving their problems as follows:

- Hand layout is eliminated.
- Improved accuracy reduces fitting.
- Important lead time savings are accomplished.
- The machine is more productive and results in manufacturing savings compared with previous equipment.
- Holes are accurately located.
- Holes are accurately machined because the machine is rigid.

Maximum Flexible Automation

The standard adjustable Burgmaster controls permit the machine to be quickly set up from one job to another. These include pre-selective spindle speeds, infinitely variable pre-selective feeds, selective rapid approach and return, skip indexing, depth control, and simple manual controls for set up.

The G. E. numerical system controls all machine functions, selects spindles in any sequence, automatically positions the table on two axis, clamps the table while machining operations are performed, and controls coolant. Up to 6 or 8 different operations can be performed at any command position without moving the table, or as many cycles using one tool as desired, without indexing. All operations are carried out at their most efficient rate for high finish, precision, speed, and longest tool life.

Savings in tooling and many other indirect ways will quickly pay for a Tape Controlled Burgmaster. Get the facts on your work—there is no obligation.

JOB FACTS

Burgmaster 6 Spindle Tape Machine:

Controlled Turret Drilling, Boring

and Tapping Machine.

The Ingersoll Milling Machine Company:

Company, Rockford, Illinois,

Drill Bushing Plate Part:

Lot Size:

Holding: Simple Clamp — located in

corner strips

Operations: Drill 7 holes. C'bore 3 holes.

Ream 4 holes.

1018 Steel - '%." thick. Material:

Hole Location $\pm .002$ ". - .000Tolerance:

Reamed Hole - .001

Former Method: Hand layout for drill 9 minutes

9 minutes Drill and c'bore Bore & ream 4 holes 66 minutes

84 minutes total

Box column vertical single spindle Former Machine:

drilling machine and precision jig boring and milling machine.

Punch tape for Burgmaster Present Method:

35 minutes (5 mins, per hole)

Drill, c'bore and ream 31 minutes

66 minutes total

Time Savings:

Other Advantages:

18 minutes first time, next run 53 minutes as tape is now in stock.

Indirect Savings: layout eliminated, faster manufacturing, improved

accuracy, less fitting, less trucking, faster repair service, direct machine

time savings.

Write for Bulletin describing Burgmaster 6 and 8 Spindle Tape Controlled Turret Drilling, Tapping and Boring Machines. Thirtyminute 16mm sound film showing all Burgmaster Turret Drills in operation is available from any office without charge.



MANUFACTURING COMPANY, INC.

15001 South Figueroa Street, Gardena, California **FAculty 1-3510 DAvis 9-4158**



BURGMASTER DIRECT SALES OFFICES:

Ridgewood, N.J. 86 North Maple Ave. Glibert 4-3002

4908 Lincoln Ave LOng Beach 1-1178 Cleveland 7, Ohio 4706 Detre

Detreit 37, Mich. 13730 W. Eight Mile Rd. Lincoln 8-4333 San Francisco, Calif.

Plus dealer representatives in other industrial centers.



WHEN YOUR SPECIFICATIONS CALL FOR THE *FINEST* IN CAMS...

For over half-a-century Rowbottom has been producing cams for America's industrial needs. Servicing blue chip giants and small companies alike, we act for many customers as a virtual "cam department," staffed with experts familiar with every type of cam requirement.

Whatever your cam needs — box, barrel, face or index — we can do the job to your specs. In addition to milling, we harden and grind any material or analysis. Our cam capacity ranges in size from one inch to a mammoth six feet!

We also manufacture Cam Millers, Cam Grinders and Rotary Profilers. Complete details available upon request.

THE ROWBOTTOM MACHINE COMPANY

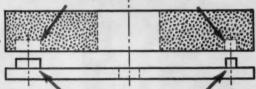
SHEFFIELD STREET . WATERBURY . CONNECTICUT

42



Gardner disc features add safety... improve accuracy

Gardner TRU-LOK® disc mounting truer running—closer precision



Proper centering of disc on steel wheel assured by Tru-Lok.

Greater accuracy—Tru-Lok eliminates run-out and vibration caused by off center mounting.

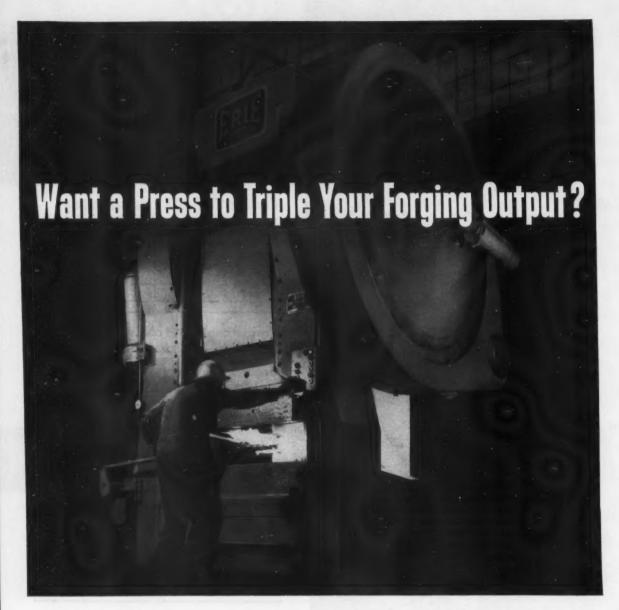
Gardner WIRE-LOKT® construction
maximum safety—maximum economy



Full value—the entire rated thickness of the abrasive is usable.

Safety—heavy, imbedded steel mesh assures maximum safety.

Call the man who can give you the most in practical, cost saving help with your flat surface grinding... your Gardner Abrasives Specialist. GARDNER



We'll build the press for all your forging requirements . . .

Tell us your forging problems and give us your production specifications—we'll do the rest.

Erie Foundry, one of the first companies to automate forging, can provide specially designed high volume presses in capacities of 1000 to 8000 tons. Instead of the three machines and nine men formerly required, now you need only one Erie automated forging press and only one operator observer—to triple your present production rate! Trimming, too, can be accomplished in a single production cycle. With billet supply and finished part removal conveyorized, it is possible to achieve a production volume of, say, 1200 track-link forgings per hour.

Erie Foundry has a complete line of machines designed for high volume production of such parts as

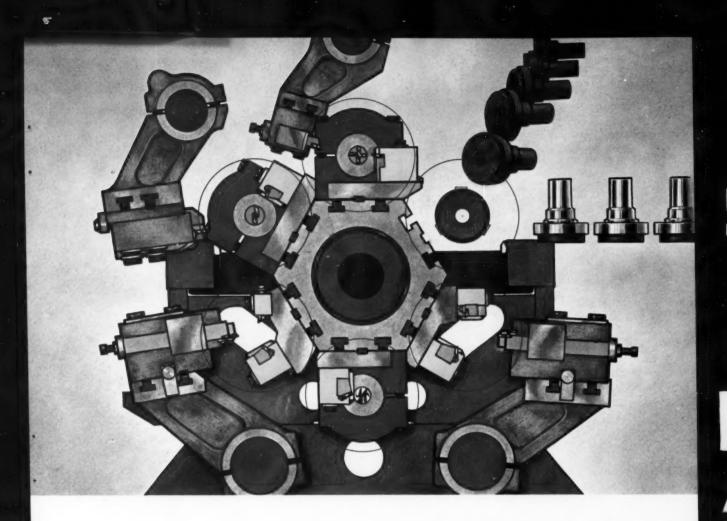
connecting rods, gear blanks, automotive and tractor valves, pinions, track links and wheel hubs.

We would like to discuss application of automated presses to your production requirements. For the complete story, phone or write Mr. R. E. Sanford, Erie Foundry Company, Erie 5, Pa.



ERIE FOUNDRY CO.

The world's great name in forging since 1895



Open secret of New Britain superiority

Wide-open design makes the most fundamental difference between a New Britain automatic chucking machine and other machines. It speaks for itself as a means of getting at the tooling, making adjustments and clearing chips.

Massiveness, right from the floor up, is equally apparent and equally important in chucker work. You see it in the way the cutting tools make the heaviest cuts with a chatter-free smoothness that can't be duplicated.

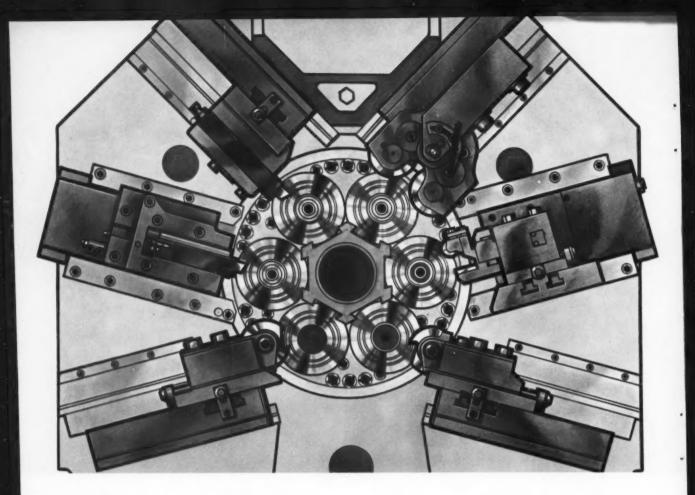
Only New Britain provides a combination of longitudinal with transverse forming motion where needed. This versatility eliminates the need for second operation machines in many cases—particularly when a job is setup for double indexing

for fast two-at-a-time production.

New Britain spares no pains to incorporate every new development to make chucker-type machining more profitable. The open-end design lends itself particularly well to magazine loading and unloading, for example, and many New Britains are being equipped to provide this feature.

Whenever a number of operations are required on cast or forged pieces, these massive, rugged, powerful machines offer great possibilities for savings through faster, more accurate, more reliable production. A new and complete catalog on the New Britain chucker line is just off the press. We would be very glad to send you your copy.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division • New Britain, Connecticut



New Britain's answer to a serious threat

Overseas production of just about anything you care to name is making serious inroads on American domestic and foreign markets. It's no secret that European and Asian industry is catching up fast technologically—and they have a real competitive advantage in plenty of low cost skilled labor. While many foreign products are still inferior to those of domestic manufacture, this is far from true in all cases. The answer is, of course, increased productivity at lower cost.

In its all-new line of bar machines, New Britain has developed the most modern bar-turning units available. Five models in two different series are offered with capacities from $1\frac{1}{4}$ " to $5\frac{1}{8}$ ". These machines are designed for really fast, trouble-free, high-precision production. More operations

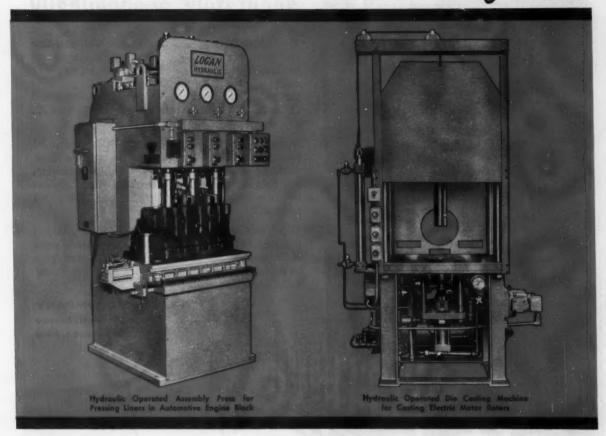
per machine are possible than ever before. Wide open tool areas allow unlimited combinations of end working and forming tools. New Britains will stay new longer. The exclusive wear-preventing features so familiar to New Britain users have been retained and improved. Catalogs on both the small and large series machines are yours for the asking. After looking this literature over if you think one or more New Britains may help improve your competitive situation, we will be happy to review your prints and arrange a demonstration. No obligation, of course. Call us or call your local representative.

New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut

BE SURE!

Look to Logan



when you require special air or hydraulic-operated equipment for PRESSING • STAKING • FORCING CASTING • FORMING • SIZING

For more than forty years Logan's special services department has engineered and built special equipment to industry's exacting requirements. Logan engineers are always available to help you with your special applications.

for further details ask for bulletin 7-A

LOGANSPORT MACHINE CO., INC.

810 CENTER AVENUE, LOGANSPORT, INDIANA

BIO CENTER AVENUE, L	
PLEASE SIND COPY OF CATALOG	
100-1 AIR CYLIMBERS 100-2 MILL-TYPE AIR CYLS. 100-3 AIR-BARAILE CYLS. 100-4 AIR WALVES 100-5 LOGARSDBARE CYLIMBERS 100-5 UGARSDBARE CYLIMBERS 100-5 ULTRAMATION CYLIMBERS 100-6 ULTRAMATION CYLIMBERS 100-7 PRESSES	000-1 HYD, POWER UNITS 700-2 REFOCAST HYD, CYLS. 700-2 750 SERIES WYD, CYLS. 700-4 AND 200-7 WYD, VALOU 700-6 SERIES HYD, CYLS. 700-1 CHOKES ARC BOOKLET CHOKEST BIRDER CHOKEST
10:	
HAME	TITLE
COMPANY	

MEMBER: National Machine Tool Builders' Assn.; National Fluid Power Assn.

Yoder Roll-Forming Equipment mass-produces shapes accurately, economically

Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock... in thickness up to ¾ inch... in speeds up to 50,000 feet per day.

Yoder engineers flexibility and precision into metal forming operations. For example: many basic shape modifications, such as coiling, welding, notching, ring-forming, perforating, and cutting to length can be simultaneously accomplished with little or no additional labor cost.

Yoder also makes a complete line of Rotary Slitters and Pipe and Tube Mills. Profit from Yoder's years of engineering and service experience, contact your local Yoder representative or send for the Yoder Roll-Forming Manual.

THE YODER COMPANY
5504 Walworth Avenue
Cleveland 1, Ohio



This fully-illustrated 88-page book clearly discusses every important aspect of Yoder Roll-Forming Equipment and methods...it's yours for the asking!



COLD ROLL FORMING MACHINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)
ROTARY SLITTING LINES





FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL 52 Concentrate — The pink fluid which covers 85% of all metal cutting jobs.

CIMPERIAL® — Newest in the famous, industry-proven line of CIMCOOL® Cutting Fluids.

CIMPLUS — The transparent grinding fluid which provides exceptional rust control.

CIMCOUT Concentrates (AA, NC, SS) — For every job requiring an oil-base cutting fluid.

ALSO — CIMCOOL Tapping Compound — CIMCOOL Bactericide — CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

**Trade Marks Reg. U. S. Pat. Off.

CASE after CASE after CASE after CASE

An automobile manufacturer in Michigan used Norton natural diamond wheels with resinoid bond, size $3\frac{3}{4} \times 1\frac{1}{2} \times 1\frac{1}{4}$, type D11V9 for dry sharpening carbide tipped broaches. Compared to a competitive diamond wheel of similar specifications, the Norton wheel removed stock at a cost of \$25.36 per cubic inch of carbide. Stock removal costs for the competitive wheel were \$34.50 per cubic inch. The Norton wheel reduced grinding costs $26.5\frac{1}{6}$.

A mid-western manufacturer of small gasoline motors used a Norton resinoid wheel having man-made diamond abrasive, size 6 x 3/4 x 11/4, type D6A2C to wet-grind single point carbide tools. These Norton wheels, compared to another brand of similar type and description, provided twice the life of the competitive product.

A mid-western manufacturer of machine tools ran Norton resinoid wheels, of mined diamond, size $6 \times \frac{1}{2} \times \frac{5}{8}$ type D6A9 against a competitive wheel of comparable type and description for the dry grinding of carbide milling cutters. The Norton wheel lasted 521 hours compared to 300 hours for the other wheel. The Norton wheel provided 73.6% more usable life.

A western producer of aluminum used Norton resinoid-bonded diamond wheels of man-made abrasive to dry-grind carbide milling cutters. Wheel size was $5 \times 1\frac{3}{4} \times 1\frac{1}{4}$, Norton type, D11V9. Previously, the customer had been using a competitive wheel of similar specifications. The Norton wheel, compared to the other brand, cut faster and had twice the useful life.

Norton Diamond Wheels -Mined or Man-madeout-grind them all



Norton was first to introduce all three kinds of diamond wheel bonds: resinoid, metal and vitrified . . . does all its own checking and sizing of diamonds . . . duplicates wheel specifications with constant accuracy.

Resinoid bonded diamond wheels are best for such jobs as precision grinding of cutters, form tools and die blanks. They are available in several bond types — B type for wet grinding — B6 type for dry grinding.

Vitrified bonded diamond wheels are used for sharpening single-point cutting tools, grinding chip grinders and for surfacing carbide dies.

Metal bonded diamond wheels are sometimes preferred for grinding chip breakers, for certain offhand grinding jobs and for cutting off sintered carbide blanks, etc.

Norton leadership in diamond wheel

manufacture continues whether the diamonds used are natural or manmade.

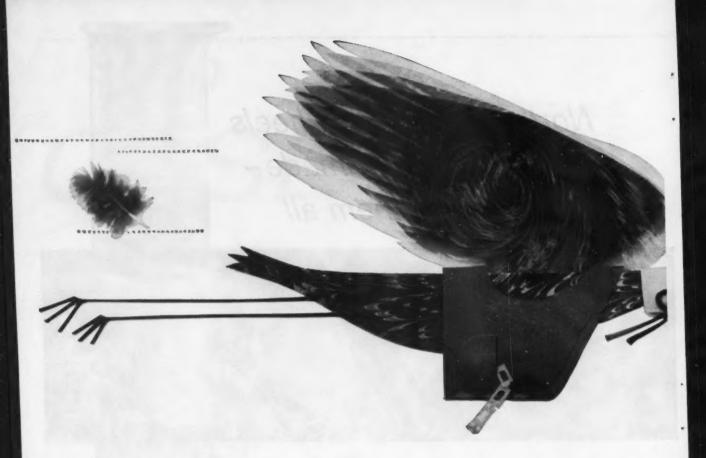
As the world's largest producers of abrasives, Norton maintains the most modern equipment designed for product quality control. Expert engineering assistance and prompt deliveries are also geared to provide the wheels you need for top quality, lowest cost carbide grinding. For these helpful services, see your Norton Abrasive Engineer or Norton distributor. Or write to Norton Company, General Offices, Worcester 6, Mass. Plants and distributors around the world.





W-197

75 years of . . . Making better products . . . to make your products better NORTON PRODUCTS: Abrasives · Citading Whoels · Machine Teols · Bulractories · Electro-Chemicals — BERR MANNING DIVISION: Cooled Abrasives · Sharpening Stones · Pressure-Sensitive Tapes



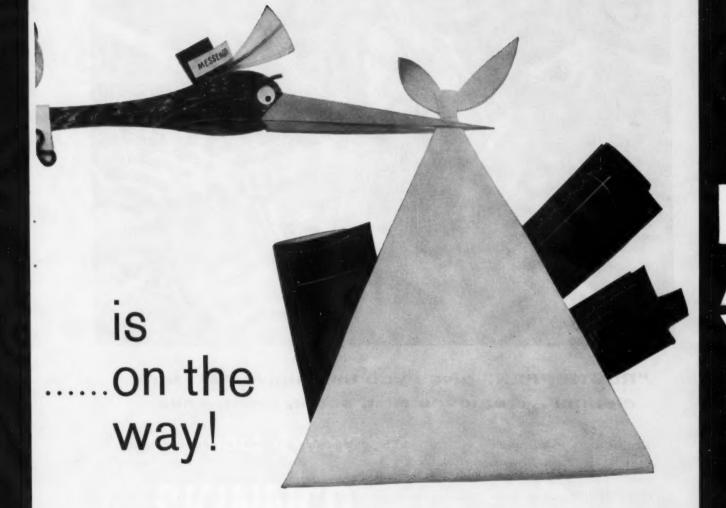
BUHR'S BABY

The first major equipment built to the Special Machine Tool Standards is on the way. And it's Buhr's Baby! A lift-and-carry type transfer that will perform 323 precision operations, Buhr's

Baby will be the most flexible and readily convertible multiple operation machine tool ever built. Manufacturing was started in December. Future ads will keep you posted on progress.

BUHR MACHINE TOOL COMPANY . ANN ARBOR

Report to the SMTS Committee



MICHIGAN

BUHFB

For a single tank cleaner to do many jobs

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE . OVER 250 FIELD SERVICE MEN . OVER 160 MATERIALS



"RUSTRIPPER" gives you the "universal" tank cleaner...removes rust, scale, paint, soils

Here is a remarkable alkaline material with powerful cleaning and chelating action. It conquers a wide variety of soils. In a tank of Oakite RUSTRIPPER, you can remove scale and rust with complete safety. It strips tough paints and phosphate undercoatings with ease. It cleans off metallic smuts, light shop soils, discolorations.

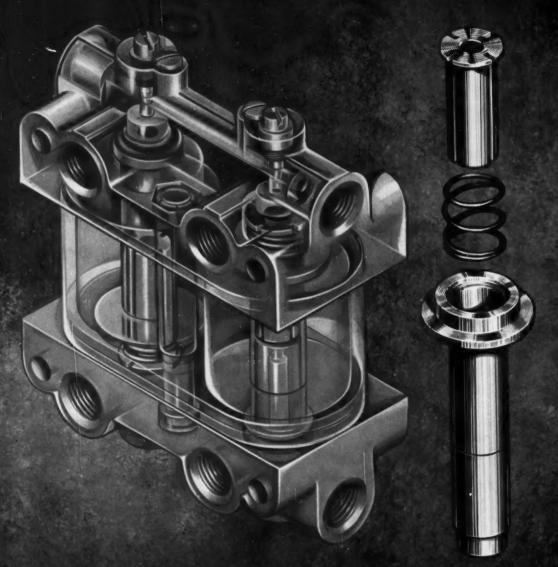
Look at its performance in shop service: "Aircraft parts freed of scale with boiling soak, instead of sand blasting"..."oil, welding flux, rust removed in job plating"..."soaked steel wrenches give brighter plate"..."removes all rust, scale carbonized oil from diesel liners prior to plating"..."displays amazing solution life even though worked very hard"..."elimi-

nates pickling and precleaning for barrel plated screws"... "does to bolts in 3 minutes what took pickling 40 minutes". And that's just a sample.

Write for Bulletin 9651. Better yet, ask the Oakite man. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite





Compact 4-way

SKINNER

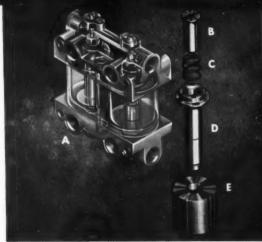
Solenoid Valves



assure precise cylinder control

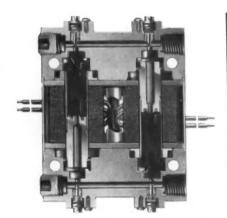
Here's how accurate, dependable operation is built into SKINNER 4-way solenoid valves

- Precise flow control-by adjustable metering
- Compact, direct acting—two 3-way valves in one housing
- Durable and corrosion resistant—stainless steel internal parts
- Leakproof, bubbletight sealing-soft, synthetic inserts
- Positive operation mounted in any position—spring-loaded plungers
- Underwriters approved—wide selection of coils, voltages and frequencies
- Wired from front or rear-housing easily reversed
- Adaptable to many uses—optional porting arrangements



A. Transparent view of 4-way solenoid valve B. Plunger C. Plunger return spring D. Sleeve E. Coil

SKINNER four-way solenoid valves available in three basic types



V9 SERIES SPECIFICATIONS

Media—air, hydraulic oils, inert gases Orifice Diameter—¾4", ½6", ¾2", ½" Pipe Size—¼" NPTF

Maximum Operating Pressure Differential—0 to 150 PSI (up to 225 PSI also available)

Temperature Range—minus 40°F. to plus 180°F. C_V Factor—%₄" .052, ½₁₆" .095, ¾₃₂" .156, ½" .214

Mounting—1/4" through-bolt holes.

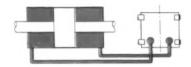
The Skinner V9 solenoid valve is two 3-way valves in one compact housing. Both valves may be independently controlled and metered to provide accurate, dependable control of single- or double-acting cylinders, or larger pilot-operated valves.

V9 types are available without adjustable flow and with metering at both exhaust ports, both inlet ports or full metering of all ports.

For complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below. Normally closed—normally closed V933 valves with a neutral position. Generally applied on double-acting cylinders where the piston is in a neutral position without pressure when both coils are de-energized. This permits manual shifting of the piston without operating the valve.

Normally open—normally open V955 valves with a neutral position. Generally applied on double-acting cylinders where both sides of the piston are to be open to pressure when both coils are de-energized. Under certain conditions, the first operating stroke of double-acting cylinders will be smoother with this valve in use.

Normally closed—normally open V935 valves with no neutral position. Generally applied on double-acting cylinders where the piston is to be in retracted or extended position with pressure when both coils are de-energized. Wiring is simple—both coils are operated simultaneously and can be controlled by one single-pole, single-throw switch.





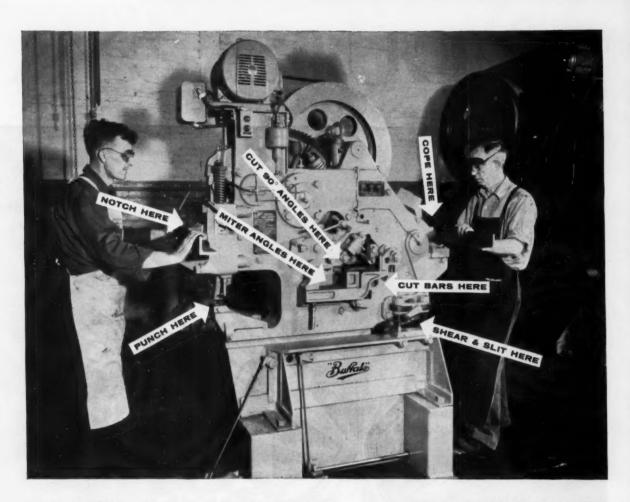


When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed nationally.



SKINNERVALVES

THE CREST OF QUALITY THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.



SEVEN OPERATIONS—SAME MACHINE

SAVES ON MAINTENANCE AND PRODUCTION

A BUFFALO Iron Worker can be the most useful, productive and cost-saving machine in your shop.

Without changing tools, it will do a variety of jobs — several at the same time.

It's compact, ruggedly-built, requires practically

no maintenance and is available in your choice of sizes and models.

Worth investigating, a BUFFALO U. I. W. pays its own way and returns dividends. Maybe you can't afford to be without one. Write for Bulletin 322 or . . . better still . . . call in your nearest BUFFALO representative.



BUFFALO FORGE COMPANY

440 Broadway . Buffalo, N.Y.

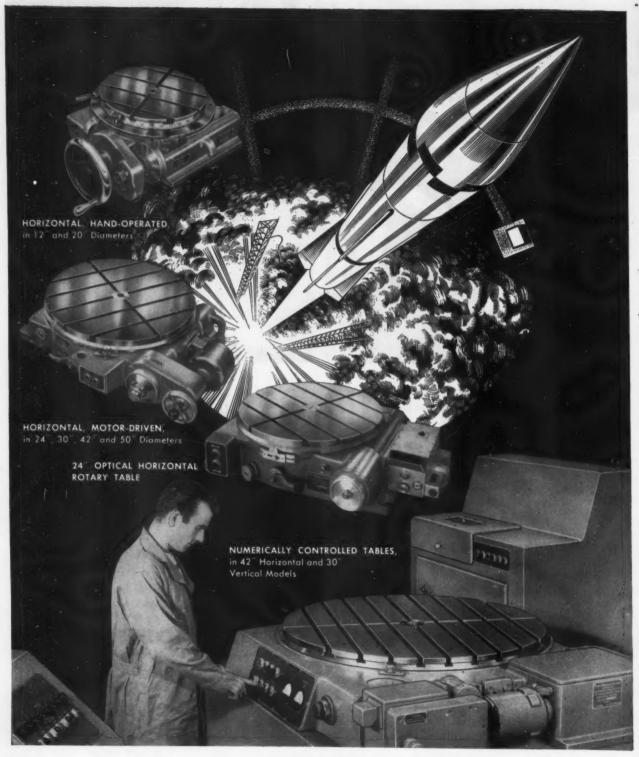
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING . PUNCHING . SHEARING

• BENDING

You're better off with Buffalo Machine Tools to Drill, Punch, Shear or Bend.

ACCURACY



ASSURED...

Where pin-point precision is essential! PRATT & WHITNEY Precision ROTARY TABLES

In the spacecraft and missile field . . . and in a very wide range of other applications throughout industry, Pratt & Whitney Precision Rotary Tables are first choice wherever the ultimate in dependable accuracy for circular spacing and angular position is a must! Playing an important part in America's spacemissile program, P&W Rotary Tables are used for machining, calibrating and testing in the construction of the missiles. They are also used for the extremely critical job of aiming the missiles for firing. Accurate to 2 seconds of arc, the tables used for aiming are equipped with optical attachments and are employed as azimuth indicators.

Providing the right type and size for every requirement, only Pratt & Whitney offers a truly complete line of precision tables. As shown on these pages, Horizontal,

Vertical, and Tilting types, in Hand-Operated and Motor-Driven models, are supplied in 12" to 50" diameters. Optical, Automatic Indexing, and Numerically Controlled types are also produced. Certified accuracies as high as 2 seconds of arc—from any point to any other point within a full 360°—can be supplied.

If your operations involve circular spacing or angular positioning, the logical tool to reduce costs and insure greater accuracy is a rotary table. And to insure the model and the precision you need, it's logical to choose a Pratt & Whitney Certified Accuracy Rotary Table. For complete information, call the P&W Branch Office in your area... or write direct, outlining your requirements.

PRATT & WHITNEY COMPANY, INC.

12 Charter Oak Boulevard, West Hartford, Connecticut



PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS . GAGES . CUTTING TOOLS

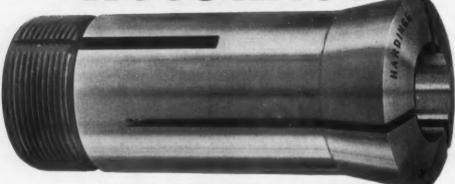


in 10", 16", 24" and 36" Diameters

MACHINERY, May, 1960



ACCURACY ACCURACY ACCURACY ACCURACY ACCURACY



ACCURACY ACCURACY ACCURACY ACCURACY

HARDINGE has specialized in the manufacture of collets since 1890.

HARDINGE today stocks collets in sixteen principal cities in the United States and Canada.

Ask for descriptive bulletins.

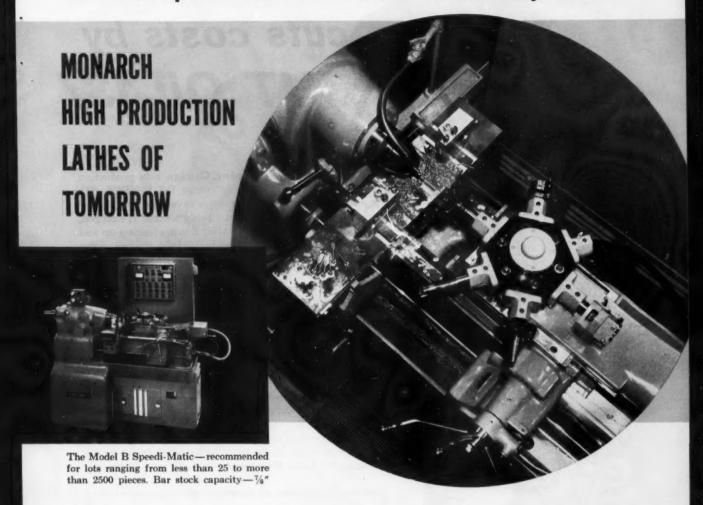
HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

Collet stocks are available in Atlanta, Elmira, Portland, Boston, Hartford, New York, Philadelphia, Oakland, Seattle, Dayton, Detroit, Chicago, St. Louis,
Minneapolis and Los Angeles, also Toronto, Canada.

60

Don't Tool Up for Tomorrow's Boom with Yesterday's Lathes



5. The New Model B Speedi-Matic... A Fast, Precision, Hand Screw Machine

Speed and accuracy of output have always typified the Monarch Speedi-Matic. Now with the latest developments in electronic speed control, a hydraulically powered turret and a host of other improvements, the 5 H.P. Model B is even better adapted to today's exacting requirements. Major features include:

(1) A control center that provides preselected, automatic speed and feed change for each tool position. Speed range is infinitely variable from 40 to 4000 R.P.M.; feed range, infinitely variable from 1/8" to 16"

per minute. You get the most efficient speed and feed for each operation. consequently maximum production.

(2) A power feed, ram type turret, the turret head of which is hydraulically indexed, hydraulically located in the new position to an accuracy of less than .0002" and hydraulically clamped in position. It is also automatically lubricated.

(3) A feed box, powered by an electronically controlled feed motor.

(4) A powerful, lever operated, selfcentering cut-off and forming slide that moves on preloaded ball bearings and carries its own forced feed lubrication system.

(5) Electrical controls to J.I.C. standards. The spindle and feed control elements are in the form of plugin modules for ease of maintenance.

(6) Simplicity of setup to the degree that the time is regained during production of the first few pieces.

If one of your problems is the economical production of precision screw machine parts in small and medium size lots, then the Model B Speedi-Matic is for you. It will take only a few moments of your time to write for full information. ... The Monarch Machine Tool

Company, Sidney, Ohio.



This shop cuts costs by using STANICUT Oil 137

Machines seven metals, one plastic with this one cutting fluid Shank Manufacturing Company, Chicago, cuts production costs three ways by using Stanicut Oil 137 BCS. (1) The 15 Warner & Swasey Lathes are never down for change of cutting fluid when the metal being worked is changed. There's no time lost with shutting down, cleaning up and changing oil. (2) There are no losses from the use of the wrong cutting fluid. (3) Floor space is used for productive machinery instead of being tied up as storage space for barrels of different cutting fluids.

Titanium, brass, alloy steel, aluminum and seven grades of Stainless plus Teflon plastic are all worked on the machines. Latest equipment, a reputation for good work, experienced operators and on-time delivery keep business coming to Shank. STANICUT Oil 137 BCS helps Shank hold down manufacturing costs.

Does cutting costs with a cutting fluid interest you? Let one of Standard Oil's experienced lubrication specialists show you how STANICUT Oil 137 BCS can do it. Call the Standard Oil office nearest you in any of the 15 Midwest or Rocky Mountain states. Or write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.



Commercially pure AMS 4921 Titanium oxygen injector nozzle gets an inspection from Frank Kruppe, Shank president (right), and Standard Oil's Henry Krueger, Hank Krueger provides Shank plant with technical service on cutting fluids and lubrication. Hank has the experience for this work, He's been doing it for six years. He has an engineering degree from Illinois Institute of Technology and has completed the Standard Oil Sales Engineering School course.

Quick facts about STANICUT OIL 137 BCS

- Has excellent extreme pressure properties. Ideal for low machinability steels.
- Has medium-low viscosity. Low enough for rapid, cooling flow. High enough to avoid "fogging".
- Non-corrosive to aluminum, titanium and all steels, tools and machines.
- . Sterile, non-irritating and non-toxic.
- Suitable for many operations—tapping, threading, drilling, gear shaving, broaching, etc. Gives excellent tool life.

You expect more from



and you get it!

BCS

"Miking up" one of the pieces Shank produces, Frank Kruppe shows Hank Krueger quality of work turned out using STANICUT Oil 137 BCS.

STEELWELD SHEAR

Operates 16 Hours a Day Cuts Components for Prefabricated Buildings



A recent Pascoe Building.

RAPIDLY forging ahead in the prefabricated steel building field, Pascoe Steel Corporation, Pomona, California, has found its Steelweld Shear to be an extremely important factor in maintaining a steady rate of production. A large amount of shearing is required to fabricate several hundred tons of steel per month.

The Shear is normally operated 16 hours a day. It is used for cutting web plates for building columns, rafters and many other building components. About 20 hours a week it is used for slitting. The machine has functioned with very little maintenance. In nearly three years of service, the clutch has never required adjustment.

For the very latest in shears and brakes, mechanically or hydraulically operated, be sure to see what Steelweld has to offer.

Write for free copy of catalog No. 2011

O BLADE



Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

THE CLEVELAND CRANE & ENGINEERING COMPANY . 5459 EAST 282nd STREET . WICKLIFFE, OHIO

...they <u>all</u> prefer PRODUCTO die sets

DIE DESIGNERS

appreciate the unlimited selection of die sets which accommodate any type of die design.

DIE MAKERS

like the amazing speed and ease of "takeapart and put-together" made possible by Qwik-Fit Guide Pins. (Safer handling, too.)

PRESSROOM FOREMEN

are convinced that Producto die sets maintain accuracy through long runs, keep production up, downtime down.

CONTRACT SHOP OWNERS

have found consistent die set accuracy, dependable delivery, and smooth performance justifies the confidence with which they specify Producto.

free assembly and disassembly, lasting accuracy,

unlimited selection of sizes and styles! Add to
these advantages the benefits of immediate service in every
industrial center through Producto's growing network of 46 branch
assembly plants and distributor warehouses...and you realize why "They all prefer
Producto". • A WEALTH OF DIE SET INFORMATION is available

to you, free, in the comprehensive, easy-to-use Producto

Catalog No. 11, and in regular issues of Die Set Digest. Write today for these valuable

aids.

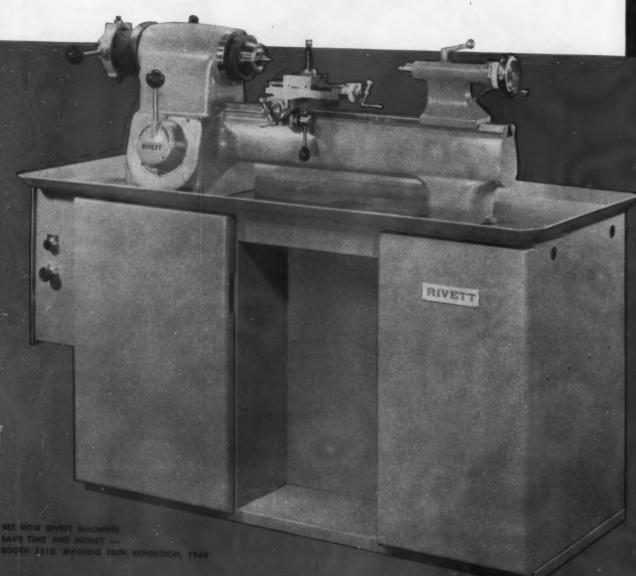
THE PRODUCTO MACHINE COMPANY

984 Housatonic Avenue, Bridgeport 1, Connecticut

PRODUCTO PRECISION DIE SET



helps you prepare for the 60's with its...



SIXTY series

precision speed lathe!

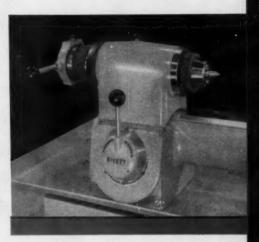
Here is a production tool of speed,
accuracy and durability
that combines the perfection
of the most modern material and
engineering skill with
the know-how of three generations
of lathe building experience.



Featuring "one motion control"

Single lever starts lathe spindle and selects any speed within the range up to 4800 r.p.m. Same lever will change speed during operation or instantly stop or reverse spindle. Stops may be set for repeating selected speeds on duplicate work.

No waiting during speed selection or speed change. There is greater ease of operation, less handling time, and an opportunity for greatly increased production.



And 4 other Rivett "Firsts" for more precision work on a greater variety of jobs!

NEW BED FORM FEATURES DOUBLE-BEVEL AND DOVETAIL. Double-Bevel positively centers tailstock in alignment with headstock and the large bearing area prevents below-center wear. Dovetail aligns compound slide rest and evenly distributes its bearing on top of bedway as tool pressure pulls against inverted dovetail.

SPINDLE WITH TRUE ROUNDNESS AND RIGIDITY. Large diameter super-precision ball bearings of highest quality fitted to in-line ground mountings assure near-perfect ovality. Constant bearing preload, unchanged by speed or heat, holds spindle rigid against both side and end pressure of cutting tool. Unusually heavy wall and wide bearing spacing contribute to spindle's rigidity.

Endless vee belts replaced without disassembling spindle. 1-1/4" collet.

COMPOUND REST WITH HARDENED STEEL SLIDES. All mating slides are machined from steel, then fully hardened and ground. Feed screws will continue free from backlash; they are ball bearing mounted and have heat treated threads turning in nuts which automatically compensate with wear.

Contrasting black markings on white dials record feed of cross slide "on diameter" and feed of compound slide in direct linear motion. A clamping handle located in

A clamping handle located in front for maximum convenience aligns and locks slide rest to bed's top surface and dovetail.

5 DISTORTION-FREE MOUNTING. Uneven or non-rigid floor cannot distort lathe. Bed has three-point mounting on a steel channel isolated from any distortion of cabinet.

RIVETT LATHE & GRINDER, Inc.

Dept. MA-5 Brighton 35, Boston, Massachusetts



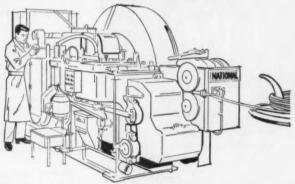
MADE FROM WIRE!

BOLTMAKERS make these interesting parts, and countless others, every day from wire.

Operations include cutting off, extruding, heading, trimming, pointing and thread-rolling.

It's just possible *your* metal parts can be made faster, stronger and at lower cost in Boltmakers (or in other types of Nationals).

May we help you investigate?



NATIONAL 1/2-INCH BOLTMAKER 4,200 PARTS PER HOUR!

Founded 1874—DESIGNERS and BUILDERS OF MODERN FORGING
MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS
BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS
CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING
PRODUCTION METHODS

NATIONAL MACHINERY CO.

TIFFIN, OHIO, U.S.A.

HARTFORD

68

DETROIT

CHICAGO

STERLINGS

No. 2 Chuck and Segments



FOR MORE CLOSELY
CONTROLLED, COOLER
SURFACE GRINDING AT
LOWER THAN USUAL COSTS.

Available for chuck sizes ranging from 8" to 42"

STERLING

STERLING

RLING WH

STERLING GRINDING WHEEL CO., TIFFIN, OHIO

GRINDING

Your best industrial distributor naturally carries full stocks of STERLING GRINDING WHEELS. For quick contact and delivery, get in touch with him today.



CHECKING THE INVOLUTE PROFILE OF A SPLINE BROACH. Broach's 6" pitch diameter is designed to cut 48 splines—hold accuracy of +.0002"-.000" on all splines for 30". This accuracy is possible on broaches up to 82" when made of Rex High Speed Steel.

NOW, BROACHES PRODUCE

MORE PIECES FASTER They're also producing pieces with finer finishes and greater accuracy — because they're made of continually-improved Rex® High Speed Steels.

New broach designs and new broaching machines now enable you to mass-produce complex shapes in a matter of minutes. Furthermore, every piece is finely finished to within micro-inch tolerances.

What is behind this development? It's the increased skill of the broach tool makers, combined with Crucible's progress in making better high speed steels.

To produce the fine steels needed for broaches, Crucible tool steel specialists make use of the most advanced electronic instrumentation available today. For example: they use precision instruments to control the temperature of the molten metal in the melting furnace. So, each heat is produced under identical conditions.



CHECKING THE TOOTH SPACING OF HELICAL INVO-LUTE SPLINE. Finishing teeth on broaches made of Rex High Speed Steels reproduce shapes within tolerances of a few ten-thousandths of an inch.

Crucible tool steel specialists employ new techniques that greatly improve deoxidation of the liquid steel. They also use new ingot mold designs that provide freedom from segregation when the steel solidifies. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging.

Today Rex High Speed Steels continue to make the best broaches because they offer 1. more uniform distribution of carbides throughout the section. This ensures minimum size change, greater predictability in heat treatment, greater hardenability and more uniform hardness in the heat-treated tool. And 2. more uniform distribution of sulfides in the free-machining grades—which provides improved machinability and superior surface finish.

To make precision tools better with Crucible's Rex High Speed Steels, call or write the nearest Crucible branch office or warehouse.



BETTER TOOLS, THROUGH BETTER STEELS. The constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, taps, twist drills and cutters—as well as broaches.





CRUCIBLE

STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J. • Charlotte Chicago • Cincinnati • Cleveland • Columbe • Dallas • Dayton • Derver • Detroit • Erie, Pa. • Grand Rapids • Houston • Indianapolis • Los Angeles Miami • Milwaukee • Minneapolis • New Haven • New York • Philadelphia • Pittsburgh • Portland, Ore. • Providence • Rockford • Salt Lake City San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tulsa

Talide Dies Cut Maintenance Costs at REVERE COPPER!





REVERE COPPER & BRASS, INC., ROME, NEW YORK, producers of copper clad, stainless steel kitchenware

found aluminum bronze dies gave better production than steel alloy dies, but maintenance costs still remained high. Over 500,000 one-quart sauce pan bodies were being drawn with each aluminum bronze die costing \$250, but it cost another \$900 to maintain the die in operation.

It was necessary to hand polish the die in the press every 2,000 pieces. After each 10,000 piece run, the die had to be taken to the tool room to have .010 to .030 of stock removed from face to clean up. Downtime and maintenance expense was costly.

A Talide die costing S1150 was installed and production now averages over 1,000,000 pieces with no visible wear. It was only necessary to hand polish the carbide die several times during the break-in period while drawing the first 30,000 pieces, with subsequent servicing negligible. More uniform, accurate-to-size parts are produced with scoring eliminated. No subsequent buffing operation on the piece part is required.

During the past 15-year period Revere Copper has installed over 30 Talide dies on their production line—pressing to shape a broad variety of kitchenware items, including sauce pans, covers, double boilers, percolators, handles, etc. Although millions of piece parts have been drawn to date, no Talide die has yet been worn out!



WIRE DIES

Hundreds of miles of steel and non-ferrous wire—.004 to .750—drawn through TALIDE dies.



COLD EXTRUSION DIES

50 times more valves and tappets cold extruded with solid TALIDE punches and dies,



paper discs blanked out with TALIDE—over hard alloy die.



CURLING ROLLERS

TALIDE
curling rolls
last 65 times
longer than
steel rolls on
beverage can
forming
operation.



SWAGING

Leading fountain pen manufacturer cold swages 33 times more stainless steel parts with TALIDE dies.



HEADING AND EXTRUSION DIES

Cold heading 1/4" C-1008 rivets, TALIDE dies produced 11,200,000 pieces, other carbide dies only 3,500,000.



Compacting highly abrasive chemical powders, TALIDE pill dies last 4 months; steel dies wore out in 6





A Talide die engineer can help you cut costs and increase production on draw presses, punch presses, pill presses, cold headers, swagers and draw benches. METAL CARBIDES CORP. 6001 Southern Boulevard Youngstown 12, Ohio

Youngstown 12, Ohi Send for 68-Page Catalog 59-G



HOT PRESSED AND SINTERED CARBIDES . VACUUM METALS
HEAVY METAL . ALUMINUM OXIDE . HI-TEMP. ALLOYS
OVER 25 YEARS EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY







Specify 5

ALLEN-BRADIX

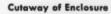
COMBINATION STARTERS IN SPIN-TYPE ENCLOSURES

Here's Allen-Bradley's Bulletin 713 combination starter with circuit breaker—featuring conveniently removable spin-type cover and base—for use in hazardous gas and dust locations. Inside you'll find the time-tested A-B Bulletin 709 solenoid starter.

The consistent reliability of Allen-Bradley solenoid starters is a result of their design simplicity. With only one moving part, there's virtually nothing to go wrong—this is your assurance of millions of trouble free operations. In addition, the double break, silver alloy contacts are always in perfect operating condition—and remain so with no service attention. Also, all A-B starters have two permanently accurate thermal relays that protect motors against dangerous overloads. The reliability of these relays is not affected by atmospheric conditions.

To insure maximum production with minimum maintenance, always insist on Allen-Bradley quality motor control. Please write for full information.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



Shows Allen-Bradley combination starter. Screw-type cover and base permit quick access to the starter or the circuit breaker.

A-B Bulletin 713 Combination Starter



NEMA 4 Watertight



NEMA 7 Hazardous



NEMA 8 Corrosive Hazardous Gas



NEMA 9 Hazardous Dust Location

These enclosures remain available. Because of the trouble free operation of Allen-Bradley control, bolted covers are not a problem.

ALLEN-BRADLEY

Quality Motor Control



MORE MILLIONS OF OPERATIONS

with

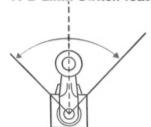
Allen-Bradley **Limit Switches**

There's nothing now on the market to match the reliability and trouble free performance of Allen-Bradley Bulletin 802T limit switches. They are completely oiltight-operating heads and switch bodies are sealed against oils, coolants, and metal chips. Operators cannot become sluggish or "stick" in operation-contacts cannot become fouled. The double break, silver contacts are always in perfect operating condition-and remain so without maintenance.

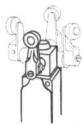
Insist on Allen-Bradley-the quality line of limit switches that will give you many more millions of trouble free operations.



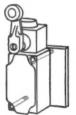
A-B Limit Switch features mean more life, more dependable trouble free service



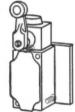
REPETITIVE ACCURACY—Unique toggle blade action assures operation at precisely the same point each time, without adjustment.



FLEXIBILITY — All operating heads can be rotated and fastened in any of four positions 90° apart.



FRONT MOUNTING



REAR MOUNTING

All Allen-Bradley Limit Switches can be mounted either from the front ... or from the rear.

ALLEN-BRADLEY

QUALITY MOTOR CONTROL

MODERN MACHINE TOOLS Production Efficiency















For more information and proof — visit us at the Machine Tool Exposition—September 6-16 International Amphitheatre in Chicago

Each of us, as represented by our trade marks shown above, will have an interesting display of modern machinery in action. The fact that "Modern Machine Tools = Production Efficiency" will be clearly demonstrated and we urge you to attend this most modern of industrial expositions.

Rockford Insert Group

May, 1960

Keep gathering metal-working production ideas...be well informed when you replace machinery.....

SUNDSTRAND "Engineered Production" METHODS

... practical ideas for men who are responsible for manufacturing quality, quantity, and profit

300-hp tracer lathe automatically loads, turns, and unloads TRACER TURNING 1800 lb. locomotive axle forgings





Over 400 lb. of stock is removed from 1800 lb. locomotive axle forgings in an 11 minute cycle on this 300 hp Sundstrand tracer lathe. Parts are loaded, tracer turned and unloaded in a completely automatic cycle. Forgings range from 4 to 12 inches in diameter and 6 to 9 feet in length.



Ends are milled to length and centered prior to turning. With this new Sundstrand Lathe, production increase averages 4 to 5 times over previous method of turning these

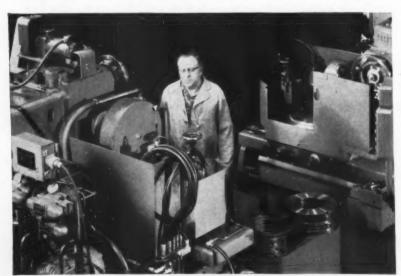
The machine has one front and one rear tracer slide, each controlled from templates which are easily changed for varying sizes of workpieces.

A similar Sundstrand lathe is used for finish turning the axles.

For details on Sundstrand tracer lathes, ask for Bulletin T-615.

ROTARY

Operator runs two machines to ruff and finish SURFACE GRINDING grind 14" clutch plates at 45 per hour.



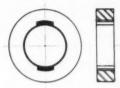
These two 20 hp Sundstrand-Arter grinders have the rigidity and power necessary for heavy cuts and fast stock removal. They ruff and finish grind clutch plates to an over-all flatness of .001", total indicator reading - repeatability within ± .0005". Required finish of 30 to 40 microinches is easily held; but finer finish is obtainable with these machines. Stock removal is from .009" to .012" per side.

The entire cycle is automatic except for load and unload, including fast feed for heavy stock removal with automatic change to slow speed for fine finish. When one side is finished on the first machine, the operator simply turns it over and positions it on the magnetic chuck of the second machine. Production is 45 pieces per hour per side per machine at 85% efficiency. Ask for Bulletin G-615.



Machinery, May, 1960

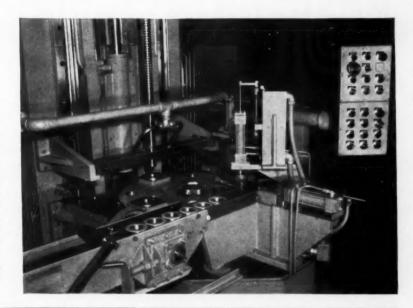
INTERNAL Fully automatic cycle loads, broaches, and unloads gear BROACHING blanks three at a time



The ID and two splines are automatically broached at a rate of 350 per hour (at 100% efficiency) by this Sundstrand-American machine.

Parts are fed into a fixture by belt conveyor, stacked three high, indexed, machined, and ejected onto the outgoing conveyor. The entire cycle is fully automatic. While parts are being loaded at one station, other parts are being broached. The machine also is equipped with automatic chip conveyor.

Bulletin No. B-615 describes Sundstrand-American vertical and horizontal broaching machines.



CYLINDRICAL Production increased 500%; equipment cost cut 60%; BELT GRINDING floor space reduced 50%



Use of a special cylindrical grinding fixture mounted on the automatic in-feed table of this Sundstrand-Engelberg belt grinder provides grinding of electric motor rotors to a tolerance of .0002 to .0004". Diameters are accurate to ±.0005". Rotors without shaft are mounted on an arbor, as shown at right. Rotors with shafts, at left, are held on their own shafts. A production cycle takes as little as 12 seconds.

The savings listed above are not uncommon wherever Sundstrand-Engelberg precision abrasive belt



grinders can be employed to replace other classes of equipment. Literature available upon request.

THE CASE STUDIES LISTED HERL ARE TYPICAL OF THE RESULTS ACHIEVED THROUGH SUNDSTRAND'S "ENGINEERED PRODUCTION" SERVICE WHICH ANALYZES YOUR MACHINING REQUIREMENTS AND ESTABLISHES THE METHODS AND EQUIPMENT WHICH WILL GIVE YOU THE GREATEST OVER-ALL PRODUCTION ECONOMIES.

FOR COMPLETE INFORMATION WITHOUT OBLIGATION, WRITE TODAY.



SUNDSTRAND MACHINE TOOL BELVIDERE, ILLINOIS . DIVISION OF SUNDSTRAND CORPORATION



ic and Ma













Machinery, May, 1960

CITY OF MACHINE-TOOL SPECIALISTS ROCKFORD, ILLINOIS, U.S.A.



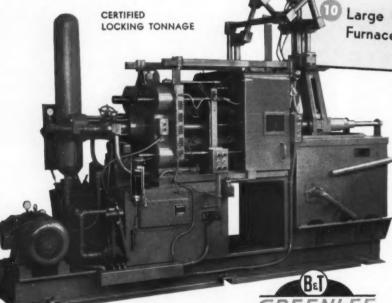
10 big reasons why B&T offers you a superior

AUTOMATIC ZINC DIE CASTING MACHINE...

The extra strength and precision built into B & T Die Casting Machines gives you thousands of hours of trouble-free operation . . . helps you to increase production and reduce operating costs.

See this B & T Automatic Hot Chamber Die Casting Machine in operation. Look it over. Note the motorized die height adjustment, automatic die lubrication, large conveyor area for automatic part removal, and many other advantages that really pay off on the production floor. Your B & T representative will be glad to make all arrangements to show you this machine.

- Extra Built-in Beef and Rigidity.
- 2 A Precision Machine.
- Four-Toggle Locking Linkage.
- Massive Tie-Bars.
- 6 Heavy, Rigid Platens.
- Automatic Lubrication.
- Motorized Die Height Adjustment.
- Automatic Die Lubrication.
- Low Pressure
 Closing System
 Protects Dies.
 - Large Capacity
 Furnace.



OTHER GREENLEE PRODUCTS

Transfer Machines
Special Machines
Automatic Bar
Machines
Woodworking
Machines
Tools for
Woodworking
Hydraulic Tools
For Craftsmen

A Complete Line of Hot and Cold Chamber Die Casting Machines Trim Presses **B&T MACHINERY COMPANY**

A DIVISION OF GREENLEE BROS. & CO. 217 W. 8th St., HOLLAND, MICHIGAN, Phone EXport 2-2341



Machinery, May, 1960

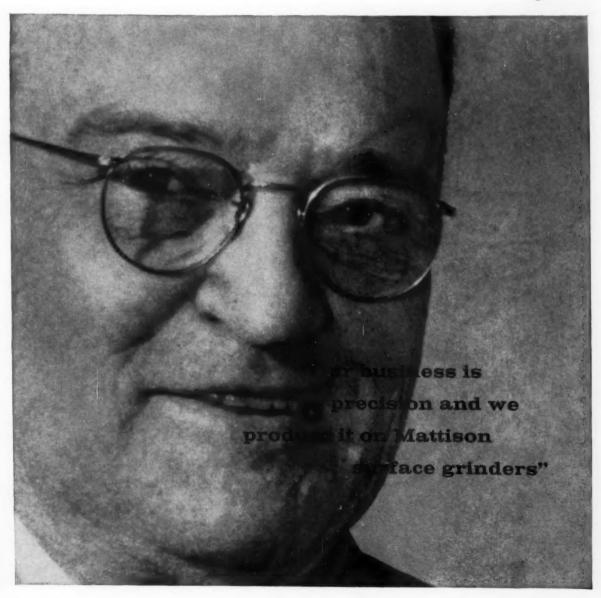
MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

PRESIDENT HENDERSON

"We are doing on a production basis the kind of grinding most people do in a toolroom. Our 16 Mattison surface grinders are the cornerstone of this operation," says Mr. C. S. Henderson, president, Marshall Steel Company. Profitable operation of a company like Marshall Steel depends in no small part upon reliability, high productivity, and remarkable precision of Mattison horizontal spindle surface grinders.

MATTISON MACHINE WORKS ROCKFORD, ILLINOIS





Machinery, May, 1960



Nothing does the job like a...





Machinery, May, 1960

ROCKFORD

PLANER

HYDRAULIC

POTTSTOWN MACHINE COMPANY MACHINES MORE WORK, AT LESS COST, THROUGH WIDE SET-UP FLEXIBILITY

SAVES 33% HOURLY COST, 15% TOTAL PRODUCTION TIME ON THIS JOB.

Operation: Using auxiliary rail, planes top and bottom pods on Paper Mill Drive base, 10' 21/2" wide x 18' 33/4" long x 3' 53/4" high, weighing 81/2 tons.

TOP: 26 pads, 6 different elevations; total area 2806 sq. in.

BOTTOM: 16 pads, one plane total area 3168 sq. in. largest pad, 12" x 54" smallest pad, 4" x 9"

Total Set-Up: 40½ hours Total Machining: 73¼ hours Average Depth Cut: ¾"

Nothing performs like hydraulic power:

- Infinitely adjustable feeds and speeds;
- Smooth, uniform cutting pressures for finer finishes;
- Maximum metal removal per HP expended;
- Low costs for machining, cutting tools and maintenance.

ROCKFORD MACHINE TOOL CO.

2500 KISHWAUKEE STREET . ROCKFORD, ILLINOIS

Pioneers In The Use of Hydraulic Power for Reciprocating Machine Tools

ROCKFORD

Machinery, May, 1960

CITY OF MACHINE-TOOL SPECIALISTS ROCKFORD, ILLINOIS, U.S.A.





THE MOST COMPREHENSIVE, UP-TO-DATE METALWORKING AND DESIGN HANDBOOK YOU CAN OWN!

ENLARGED

192 pages added in the 16th Edition

EXTENSIVELY REVISED

over 500 completely new pages of reference information and data

Whether you are a supervisor, foreman, inspector, toolmaker, machinist, student, or apprentice, you need an accurate, easy-to-use, up-to-date source of specific metalworking information.

Whether your interest is engineering, design, or production, you should have the latest facts, formulas and dimensional data available for ready reference.

Whatever your job, the new 16th Edition of MACHINERY'S HANDBOOK is a necessity. A reliable working handbook that will answer your questions, provide ready solutions to your work problems, give you information you need – when you need it.

Wherever metal products are designed and built, wherever metalworking operations are performed, MACHINERY'S HANDBOOK is the indispensable working reference. For more than 45 years it has been read and referred to on the job in thousands of drafting rooms, machine shops and manufacturing plants . . .

saving time, work and money for its users. No wonder over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

And now, in this greatly revised and enlarged edition, you get all the latest and best principles, practices, specifications, standards and other useful working data. The 16th Edition reflects the tremendous advances the metalworking industries have made; and it gives you the information you need to keep pace with that progress. The comprehensive cross-index and the convenient thumbindex will help you find any one of the subjects in seconds!

Dependable . . . accurate . . . authoritative . . . comprehensive, the new 16th Edition is the largest and best MACHINERY'S HANDBOOK ever published. Yet in physical size it is still a true HAND-book, compact and easy to use. It is the one book you will refer to again and again for the incomparable wealth of information it provides. Send for your copy today!

2104 Pages

\$ 1100

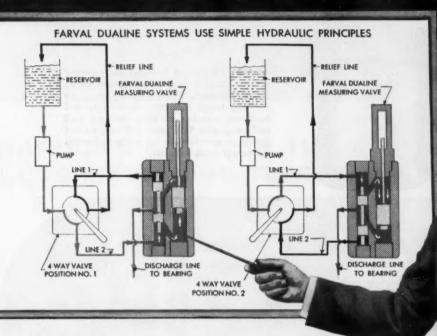
Thumb Indexed

Bound in rugged, durable Sturdite. Stamped in genuine gold. Printed on tough, thin yet whiter paper for better reading contrast. Fully thumb indexed. Designed for heavy-duty reference on the job.

THE INDUSTRIAL PRESS 93 Worth Street, New York 13, N.Y.



"For positive lubrication of large, medium and heavy-duty installations ... it's a Farval Dualine System!"



With Farval Dualine centralized lubricating systems you get the following distinct advantages over other type systems...



- (a) Much lower operating pressures with consequently less danger of soap separation on grease systems. Also, less danger of system damage due to high lubricant pressures.
- (b) Large lubricant passages with no pinhole ports, ensures practically full pump pressure for every metering valve. This is one of the reasons why Farval Dualine systems operate on lower pressures give less sieving and working of lubricants.
- (c) Positive indication at each bearing does not have to depend on the questionable action of a single indicator at the pump.
- (d) Each metering valve individually adjustable for the requirements of the bearing it serves.
- (e) Independent metering valve operation. Should trouble develop with one valve, the system will continue to operate. Only one bearing (not all the bearings) will require hand lubrication until trouble is corrected.
- (f) True lubricant metering. Quantity of lubricant delivered to one bearing is not dependent on any other valve in the system.
- (g) Much easier to spot and correct trouble.

Check with your Farval Representative and see how these versatile systems can improve production operations — reduce costs. Or write for free Bulletin 26-T containing complete engineering information on Farval Dualine systems.

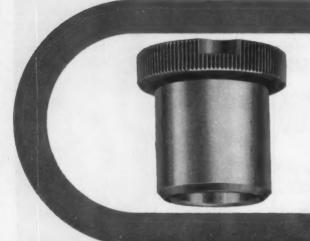
Farval Division
Eaton Manufacturing Company

3276 East 80th Street • Cleveland 4, Ohio



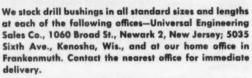
you get close tolerance drilling with

UNIVERSAL DRILL BUSHINGS



Accurately machined bushings are essential when drilling to close tolerance. UNIVERSAL DRILL BUSHINGS, of finest quality steel, are carefully tested for 100% concentricity and hardness, assuring pin-point accuracy and uniform quality. To prevent tool hang-up and breakage, each bushing has a blended radius on the top inside diameter.

All horse are superfinished. This superfinishing of bushings is important, especially in close tolerance work, because it reduces both tool and autiling wear to a minimum. Knurled head gives a guick, sure grip.



The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 134" drill size. You may have one—free—by requesting on your company letterhead. At the same time, get your copy of our new catalog that describes all of UNIVERSAL'S products including chucks, tool holders, boring bars, bushings and index plungers.

UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 2, MICHIGAN

20



BARDONS & OLIVER TURRET LATHE CUTS MACHINING TIME IN HALF. . . .

at Shafer Valve Company, Mansfield, Ohio

The Bardons & Oliver No. 3 Universal Turret Lathe is playing an important role in the story of this progressive, fast expanding firm. Over 60 different parts are made on this machine; lot sizes vary from 10 to 1000 pieces; material from brass to stainless steel is machined; and, the turret lathe is used both as a chucker and bar machine.

Operator Martin Hopp reports: "I can produce more with less effort from this machine than from other turret lathes of similar size. I have no trouble holding .001 inches on lengths and diameters."

Vice President Robert Haag reports: "We purchased the Bardons & Oliver Turret Lathe on the basis of this machine's outstanding features of performance and reliability. After using the machine for over a year and a half on a two shift basis, we are entirely satisfied with our choice."

For detailed information on any size turret lathe contact your Bardons & Oliver representative or write the factory direct.



BARDONS & OLIVER

BARDONS & OLIVER, INC., 1135 WEST 9th ST., CLEVELAND 13, OHIO Manufacturers of Turret Lathes and Cutting-Off Lathes

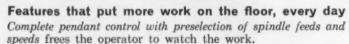
A HORIZONTAL IN A CLASS BY ITSELF

ALL-NEW GIDDINGS & LEWIS IS EVERY INCH A 6" SPINDLE MACHINE (ALSO AVAILABLE WITH 5" SPINDLE)

The voice of the customer was heard when this machine was designed! The finest in the history of a fine line of machines, the all-new Giddings & Lewis heavy-duty horizontal offers every feature and advantage sought in modern-day machining.

In a class by itself, it is constructed and powered as a 6" spindle machine, but also is available with 5" spindle in a size, weight, and price range competitive to other 5" machines... completely pendant controlled.

It offers versatility and ease of operation never before equaled in a horizontal. It is capable of taking heavy milling cuts and yet of delivering jig bore accuracy on precision boring, drilling, reaming, and tapping. It is designed for optimum production with carbide and ceramic tooling on work ranging from largediameter boring and facing to small-diameter drilling.



Joy-stick directional control for milling feeds and rapid traverse to headstock and table — moving the stick at any of four 45° angles moves headstock and table simultaneously in desired directions.

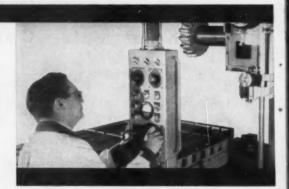
Remote clamping of head, table, saddle, and spindle lets the operator stay in one place to get more done.

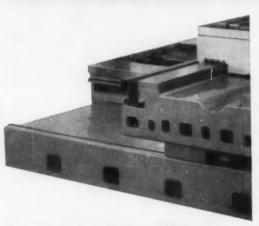
Motorized headstock provides more power for chip removal and eliminates external high-speed spinning shafts.

Massive three-way column provides inflexible stability for maximum horsepower milling and boring.

These are just a few of the new values in what is truly the most versatile high-power precision horizontal boring, drilling, and milling machine ever offered to the metalworking industry. One look at its clean uncluttered design tells you that here is unequaled rigidity, power, and precision — unequaled capability for high performance and profitable production.

For all the facts about the horizontal that's in a class by itself, send for new Catalog No. H6T. Call your local GIDDINGS & LEWIS representative or write to the factory.





Complete pendant control of every mechine function.

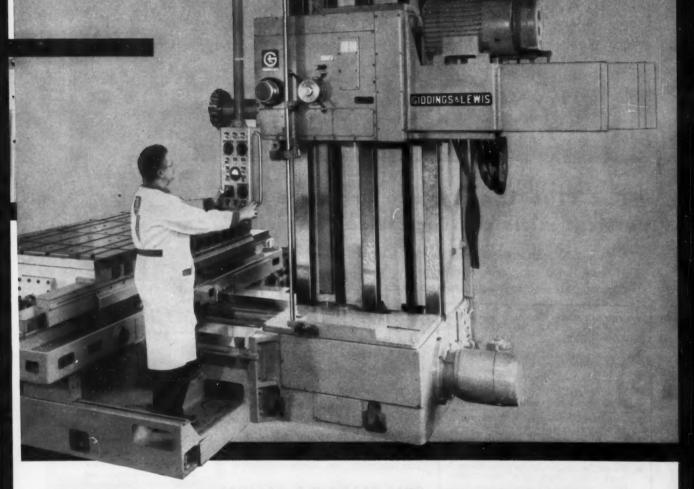
A real metal hog with jig bore accuracy.

Joy-stick control of milling feeds

Massive three-way column.

Motorized headstock.

Complete automatic lubrication.





GIDDINGS & LEWIS

GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond Du Lac, Wis.

Horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.



"The Clausing is more accurate than vertical mills costing twice the price"*

So says Harold Meyers of the Meyers Machine Co., Grand Rapids, Mich. He goes on to say: "and, we machine small parts up to 50% faster on our Clausing. You just can't beat it for small parts manufacturing."

VERIFIED ACCURACY—Before it leaves the factory each CLAUSING MILL must pass rigid tolerance tests such as:

- Top of table perpendicular to column ways within .0005" in 6" travel.
- 2. T-slots square with cross slide dovetails within .0005".
- 3. Table, parallel to turret within .001".
- 4. Spindle square with table, front to rear, within .001" T.I.R. in 5" circle.
- 5. Spindle taper (internal) runout within .0002" at spindle nose.
- Table T-slots parallel to table dovetail ways within .0005" in 8" longitudinal travel.

Enthusiasm like this, on the part of CLAUSING users is virtually universal...points up the wisdom of getting all the facts concerning CLAUSING before buying any miller.

The Clausing is perfect for general production, pattern, experimental and tool room use. It is sensitive, versatile, accurate, easy to get around . . . highly efficient on *every* job using small cutters. And the price, too, spells economy:

ONLY \$875 F.O.B. FACTORY

Write for Free Literature

The high precision spindle and drive have 7 ball bearings . . . hardened spindle. Ground and hard chrome plated quill has full length bearing in head.



The spindle head can be swiveled in a vertical plane and set at any angle, and turret rotated in a horizontal plane making it possible to machine at all angles with one set-up.

SEE US AT BOOTH 1931 A.S.T.E. SHOW, DETROIT.

C

CLAUSING DIVISION

ATLAS PRESS COMPANY

5-108 N. PITCHER STREET . KALAMAZOO, MICH.

IMMEDIATE DELIVERY



STYLE 22 HYDRAULIC POWER UNIT



STYLE 20 HYDRAULIC POWER UNIT



STYLE 502 LEAD SCREW TAPPING UNIT

Ex-Cell-O Hydraulic Power Units in Stock Now to Cut Your Machine Tool Lead Time and Production Costs!

HYDRAULIC POWER UNIT

Reduce lead time, increase productivity, and cut per-unit cost with Ex-Cell-O Quill-Type Hydraulic Power Units—immediately available for drilling, counterboring, spot-facing, and reaming operations, or as prime movers for milling equipment.

Ex-Cell-O Hydraulic Power Units are self-lubricated . . . built for easy installation, and trouble-free operation, even under fast cycles and continuous production. Compactness allows close center distance installation, in-line or radial . . . versatility makes them ideally suited for special-purpose, high production machines. A companion product, the Style 502 Tapping Unit, uses a lead screw for trouble-free tapping.

See your Ex-Cell-O representative or write direct for full information on the complete line of Hydraulic Power Units and our Canadian-built Lead Screw Tapping Unit.

EX-CELL-O FOR PRECISION

EX-CELL O PATRISION PRODUCTS INCLUDE: MICHINE TOULS . CRIMDING AND BORING SPINOLES - CHIMING TOULS - AMERICAN PINS A DEPLEMENT - ORANGE - ORIGINAL SPINOLES - ATOMIC ENERGY

Machinery Division

FX-CFLL-0

FRIGT

CORPORATION

DETAILS 15, MICHIGAN

604

Hydraulic pre-selection of speeds set by handwheel and read on illuminated dial. 16 spindle speeds—ratio 1:50—up to 310 rpm for carbide machining on Model KE 100. Table runs on tapered roller bearings.

Fingertip control for direction of feed and rapid traverse with spring-loaded mono-levers for normal direction plus angular compound feeds. Mono-levers move in same direction as desired feed or traverse movement, simplify correct setting by operator. Specially designed electro-magnetic disc clutches disengage feed instantly with no over-riding or coasting.

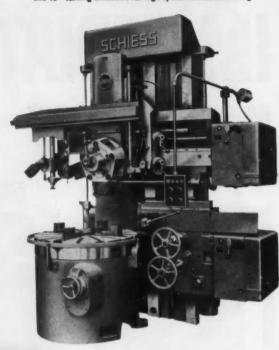
Counterbalanced cross rail and side head.
Single lever unlocks, raises or lowers, and locks cross rail simultaneously by electro-mechanical controls.

No bolts or nuts to loosen or tighten by hand.

Slip ring motor provides smooth "load sensitive" acceleration and braking. Variable speed as well as constant cutting speed available. Motor mounted on left side of machine with separate control enclosure. Fingertip control assured by pendant mounting of all necessary control functions. Electrics supplied from all U. S. manufacturers.

Copying attachment with electric tracer for use on cross rail or side head.

Model KE Single Column Vertical Turret Lathes with 40", 50" and 65" turning diameters for high-speed carbide machining.



See why tool engineers call these heavy producers,

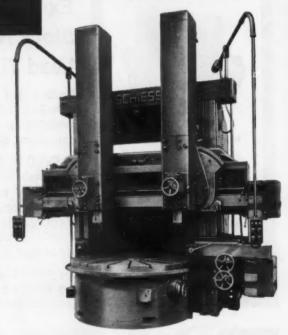
"MOST MODERN MACHINES
OF THEIR TYPE"

All operating features of KE Series Vertical Turret Lathes are combined in

SCHIESS KZ DOUBLE COLUMN VERTICAL BORING MILLS, PLUS-

Heads equipped with steel octagon rams can be swiveled—have automatic feed in vertical, horizontal and angular direction and are independent of one another as to amounts and direction of feed. Table, feed and rapid traverse controls are all contained in the pendant station. Standard model KZ Double Column Vertical Boring Mills are available with 65", 80", 98" and 118" turning diameters.

Get to know these products of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess engineer will be ready to help you size up these heavy producers for your heavy production needs. Write for catalogs and complete specifications on these and other Schiess equipment. Model KZ Double Column Vertical Boring Mills with 65", 80", 98" and 118" turning diameters.



SCHIESS

AMERICAN SCHIESS CORPORATION

1232 Penn Avenue, Pittsburgh 22, Pa.

SIEGEN WALDRICH

PLANING + MILLING

of Heavy Workpieces
In one set-up...on one machine

- Reduces machining time
- Reduces set-up time
- Increases over-all accuracy
- Cuts manufacturing costs

Write for details

Waldrich Siegen combined planing and milling machines



american waldrich mfg. corp.

1232 PENN AVENUE, PITTSBURGH 22, PENNSYLVANIA

EVEN ON THIS EXTRA-TOUGH JOB...

N-A-XTRA

HIGH-STRENGTH STEEL TRIPLES TRUCK LIFE!

Hour after hour, around the clock, the Edward C. Levy Slag Company, Detroit, keeps forty 45-ton trucks working under severe conditions. Nearly 30 tons of hot slag are loaded, lifted and dumped on every trip. Each time, the truck body must stand the sudden shock of drop loading, the stress of lifting that load and the grinding abrasive action as it empties.

How long can a truck body take such a beating?

Until the company (which designs its own trucks) discovered N-A-XTRA high-strength steel, they used ordinary carbon steel, good for about 18 months' service. Though the truck bodies were as strong as they could be and still carry an adequate payload, maintenance was almost continuous—with breaks, dents, dings and sags occurring almost from the start.

Then they fabricated eight bodies out of N-A-XTRA, which has a minimum yield strength nearly three times greater than mild carbon steel. These trucks carry the same payload and after 18 months' service still look almost new. Owners estimate a life of five years, more than triple the others—with far less maintenance. The extra strength of N-A-XTRA also permits a strong floor that needs no expensive reinforcement to support the load against hydraulic lift action.

Eventually, all forty Edward C. Levy trucks will be made of N-A-XTRA high-strength steel. In fact, all patches and section replacements are now made with N-A-XTRA.

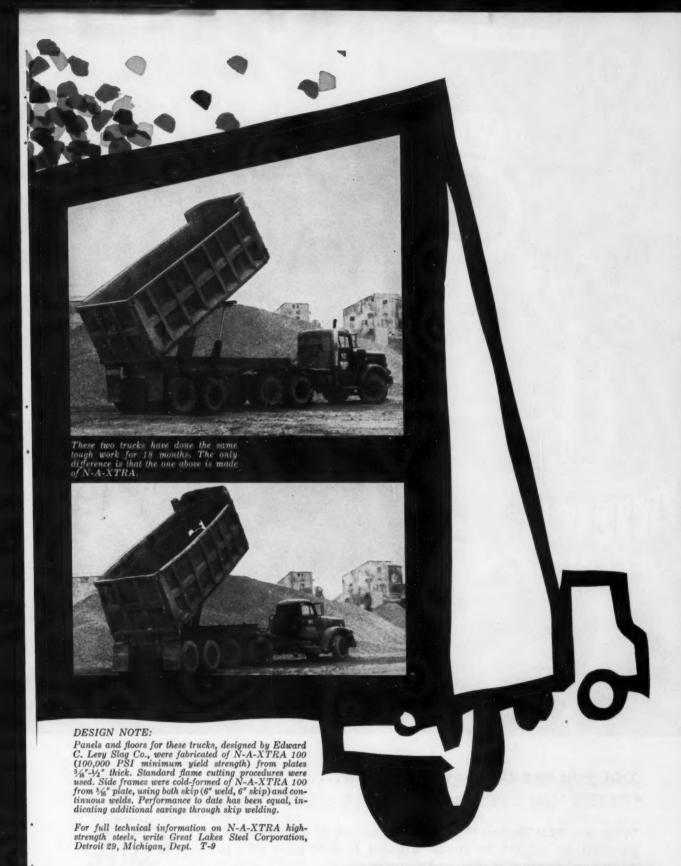
Tons of hot, abrasive slag may not be your problem—but the same steel that mastered these conditions is the one to remember when only the strongest steels will do. Rugged conditions, heavy loads and weight-saving construction are challenges that N-A-XTRA is designed to meet and beat. With excellent weldability, formability and toughness, these quenched and tempered N-A-XTRA steels are available in four levels of minimum yield strength, from 80,000 to 110,000 psi. They can also be supplied to higher levels of mechanical properties.

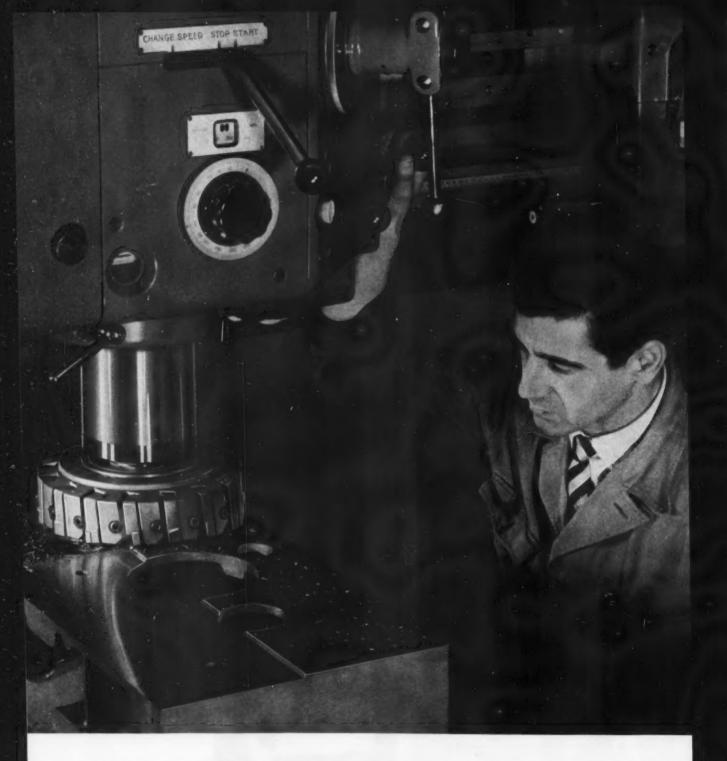


GREAT LAKES STEEL

Detroit 29, Michigan







Did you see the new SIP film...

"COST CUTTING WITH HYDROPTIC MACHINES"?

With the SIP Hydroptic, the manufacture of prototype or a production lot can be made without loss of time and the additional expense of jigs and fixtures.



For information or nearest distributor, write to AMERICAN SIP CORPORATION ONE HUNDRED EAST FORTY SECOND STREET, NEW YORK 17, N.Y.

- 14 Per Cent Capital Spending Boost Forecast
- Emergency Production Guideline Issued
- Business Tax Relief Measures Stalled
- Export Drive May Open Doors
- Washington Briefs



Keeping up with Washington

- Loring F. Overman

CHEERIEST RECENT NEWS out of Washington is the joint forecast by the Commerce Department and the Securities and Exchange Commission that spending for new plant and equipment will rise 14 per cent in 1960. The projection contemplates expenditures of \$37,016,-000,000 for modernization and expansion, as compared with 1959 expenditures of \$32,543,000,000. The latter figure represents an increase of 6 1/2 per cent over 1958.

Anticipated outlays for 1960, expressed in billions of dollars, and including percentage changes over 1959: Manufacturing, \$15.132, is up 25 per cent. (Of this

Manufacturing, \$15.132, is up 25 per cent. (Of this total, \$7.662 is in the durable goods field, up 33 per cent; with \$7.470 in non-durables, up 19 per cent.)

Mining, \$1.004, is up 2 per cent; railroads, \$1.015, up 10 per cent; other transportation, \$2.144, up 6 per cent; public utilities \$6.066, up 7 per cent; commercial and miscellaneous, \$11.655, up 7 per cent.

The report forecasts that the steel industry will chalk up its greatest sales gain on record during the year; with machinery groups showing a better-than-average increase, reflecting the capital expenditures forecast.

• Emergency Production Guideline Issued

Less hopeful than the Commerce-SEC forecast was Annex 28 to the General Emergency Production Plan maintained by the Office of Defense Mobilization, Annex 28 outlines procedures under which production would function in the event of limited or general war.

Assuming a devastating nuclear attack on the U. S., the Annex points out, industry would be expected to handle the production and distribution of essential resources under local government controls until a central Federal control could be restored.

Annex 28 also outlines how the Defense Materials System would be modified, in a general war situation, to provide automatic purchase priorities for companies producing survival items or services. Neither submission of applications nor specific authorizations would be required, the Annex notes. The emergency-invoked DMS regulation would be considered an interim measure until Federal control could be reconstituted.

Another regulation would limit distribution of specified survival items to prevent depletion of supplies. The Office of Defense Mobilization is urging all businessmen likely to be affected by emergency controls to familiarize themselves with Annex 28 and other ODM guidelines.

Business Tax Relief Measures Stalled

Political "must" legislation, coupled with the long civil rights filibuster, has eclipsed business-sponsored proposals for tax relief.

The Boggs Bill (H.R. 5), for example, to provide tax deferral for domestic companies with income substan-

tially from outside the U. S., appears to have been sidetracked, probably for the duration of this session.

Machinery people, along with the U. S. Chamber and the National Association of Manufacturers, continue to be hopeful of a tax system overhaul which will include the perennial battleground of plant and equipment depreciation, although chances for action appear remote.

More appealing, however, to legislators needing votewinning action are such proposals as Senate Bill S. 1046 which would increase the minimum wage to \$1.25 from \$1.00 and extend Social Security coverage to 7 1/2 million additional workers; H. R. 4700, which would provide medical care for Social Security beneficiaries; and H. R. 7177, which would provide temporary Federal advances to states that have depleted their unemployment compensation reserves. School construction legislation is also receiving favorable consideration.

Rapid approach of the adjournment deadline brings two unhappy possibilities—lack of action on legislation important to business or, just as bad, hasty action on matters deserving careful deliberation.

Export Drive May Open Doors

The stepped-up export trade drive, announced by President Eisenhower, may prove to be a door-opener for increased machinery sales abroad. An alternative may be increased domestic sales of machinery to those companies producing consumer items for export.

Washington Briefs

Hiring retired military officers may be less hazardous if Congress accepts H. R. 10,959, which tempers existing regulations by removing the ban (lifetime) on employment of Navy retirees by defense contractors.

Under the bill, Army, Navy, and Air Force retirees could accept sales jobs after a two-year "cooling-off" period. Criminal penalties are removed, with loss of retirement pay as the only penalty for violations. The measure retains the original bill's provision requiring defense contractors to report the hiring of any retired officer to the services with which the companies do business.

"Navy Contract Law" is the title of a new onethousand-page publication recommended for use by contractors doing business with the Navy. The publication is available from the Government Printing Office, Washington 25, D. C., at \$8.

The publication includes data and instructions covering competitive bidding and negotiations; types of contracts; research and development procedures; profit limitation; contract determination; use of industrial facilities, disposal of surplus property; and other Navyaffiliated topics.



"THE OUTSTANDING
TOOL ROOM LATHE" FOR

HARDINGE

MODEL HLV

CLOSE TOLERANCE AND FINE FINISH



HARDINGE BROTHERS, INC., ELMIRA, N. Y.

PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE

N. Y.



Industrial Complacency

WHEN this country became involved in both World Wars I and II, it was greatly handicapped because of lack of preparation for combat. Long months passed by before we were able to supply trained men to the armed services as well as armament and munitions. Both the public and government officials had been too complacent about the possibility that our nation would become involved in actual warfare. In the second conflict it took the Pearl Harbor debacle to wake us up.

Complacency in times of peace can also be disastrous so far as the economy of a nation is concerned. Right now, too many industrial companies are content to manufacture their products with equipment so old as to be inefficient—sometimes completely obsolete.

It is no wonder that competition from foreign countries has reached an ominous aspect in various instances. European plants that were devastated by wartime bombing have been rebuilt and equipped throughout with modern machinery. Combined with lower labor and material costs, this presents an advantage that cannot be overcome unless our industrial leaders take a leaf from their book and try to surpass their present manufacturing efficiency.

One builder of a radically new type of machinery has four large potential customers who have spent months in checking the quality of sample work turned out. Long tests have been under way and there has been endless correspondence between the prospective buyers and the machine builder. When, if ever, orders will be placed is problematical. In the meantime, three Japanese concerns have ordered this new equipment sight unseen.

This is no time for industrial complacency! There are concerns that have taken progressive steps to ward off foreign competition and they are doing all right for themselves. To ignore the advances of industries overseas can only affect our economy adversely.

Charles O. Herb



METALOGICS AT WORK

How Ryerson helps stainless user cut costs

Production costs for a manufacturer of stainless steel fittings were high—and rising. Parts were being machined from 1-inch round, cold drawn Type 304. Its relatively slow machining speed made blanking, drilling, threading and roughing out slow and costly. Management considered that switching to 30% faster machining Type 303 would bring costs back in line. A BETTER ANSWER: this boost in machining rates looked like a good answer—but was it the total solution? With their Ryerson Representative they studied the problem further, and realized that service demanded of their fittings didn't require all the corrosion resist-

ance of the 300 series. On the recommendation of Ryerson, they switched to Type 416 and gained two ways. It gave them a much higher machining rate—100% faster than type 304—and saved many dollars a ton in material costs.

There may be another stainless that will do your job faster, better, at lower cost. Ryerson offers more types, shapes, sizes, tonnage—and the knowledge of when and where to use them. Ryerson can handle your mill orders, too—saving you time and trouble at no additional cost.

Always be "Metalogical"-call Ryerson.





STEEL · ALUMINUM · PLASTICS · METALWORKING MACHINERY

Joseph T. Ryerson & Son, Inc., Member of the distant Steel Family

PLANT SERVICE CENTERS: BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DETROIT • HOUSTON • INDIANAPOLIS LOS ANGELES • MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SPOKANE • WALLINGFORD "Coal mining" in the atomic age



FUEL ELEMENTS FOR NUCLEAR REACTORS

EDGAR ALTHOLZ
Associate Editor

WHEN the Army Package Power Reactor (APPR-1) went critical at Fort Belvoir, Va., in 1957, it proved the practicality of using nuclear energy to power turbo-generators at remote geographical locations. Compact and portable, the Alco Products-built and operated plant has a rated thermal capacity of 10 megawatts, delivering up to 2 megawatts at the generator.

The reactor's highly enriched fuel, uranium dioxide, is utilized in the form of a powdered-metal dispersion within composite stainless-steel plates. There is also a small amount of boron carbide added as a burnable poison. Eighteen such plates comprise a fuel element. A reactor loading consists of forty-five of these fuel elements. When the reactor goes critical,



Fig. 1. (Above) Brazed fuel element contains eighteen composite stainless-steel plates.

Fig. 2. (Below) Dimensional drawing of the SM-1 fuel element shows assembly details.

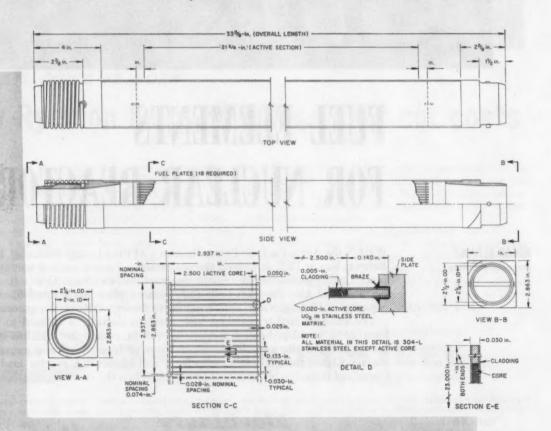
pressurized water at 450 degrees F. flows through the elements, which are stationary.

The basic element appears in Fig. 1. Composite fuel plates are disposed laterally, being separated and supported in the slots of two wrought stainless-steel side plates. Top and bottom fuel plates are longer than the sixteen intermediate ones. A centrally located rib, or comb, at each end interlocks the short plates, providing added support. Each completed unit also contains inlet and outlet end boxes which adapt it to supporting grids inside the reactor, a spring on one of the boxes to allow for thermal expansion, and a dowel-pin on the other box to facilitate positioning during installation.

Dimensions for the fuel element appear in Fig. 2. All components—fuel plates, side plates, combs, end boxes, spring, and dowel-pin—are stainless steel. This material combines the desired corrosion resistance, good physical and mechanical properties, and ease of forming and machining. Development of the fuel elements has been a long-term program at the Oak Ridge National Laboratory. This laboratory (at Oak Ridge, Tenn.) is operated by the Union Carbide Corporation for the United States Atomic Energy Com-

mission.

Proven performance of the Fort Belvoir reactor (subsequently reidentified as SM-1) has led to



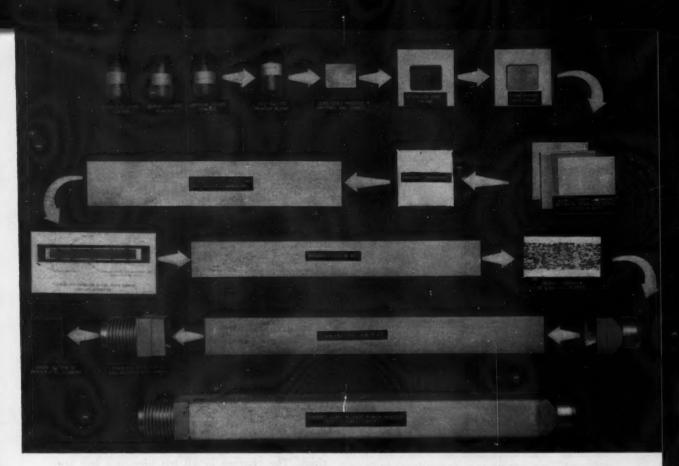


Fig. 3. "Flow chart" of components, from powders to finished assembly.

its adoption by other branches of the military as an economical source of electric heat and power where fossile fuels are unavailable. This, in turn, has precipitated the creation of a brand new industry to furnish the stationary fuel elements, and control rods and absorber rods as well.

Since any concentration of uranium dioxide beyond a critical mass will immediately set up a chain reaction and create deadly radioactivity, exacting quantitive controls govern every point of fuel-element processing, handling, and storing. A vital part of the Oak Ridge development work, therefore, has been to prescribe for industry a detailed manufacturing procedure.

The Sylvania-Corning Nuclear Corporation holds the first commercial contract ever to be awarded for the manufacture of the elements. Procedural "Bible" is the Oak Ridge National Laboratory report 2649. This work was a joint effort of J. E. Cunningham and R. J. Beaver of the laboratory staff, and R. D. Robertson and E. C. Edgar of Alco Products. The fascinating transition from raw material to fuel element at Sylcor's Hicksville, N. Y., facility is high-lighted here.

The major steps in the processing of the SM-1 fuel element are displayed graphically in Fig. 3. These are: (1) weighing and blending of the component powders (uranium dioxide, boron

carbide, and stainless steel) for each individual fuel core; (2) cold pressing, sintering, and coining into a compact; (3) blanking a stainless-steel "picture frame" for the core; (4) encapsulating the core in the frame by forming a welded "sandwich" with stainless-steel cover plates; (5) hot roll-bonding the sandwich into a fuel plate; (6) fluoroscopic inspection of the core; (7) cold rolling to specified final thickness; (8) machining to final length and width; (9) assembling and brazing of fuel plates and side plates; (10) attachment of end adapters; and (11) final machining.

All three component powders for each core are weighed separately, then poured into a blending jar. The boron carbide is poured first, the stainless steel next, and the uranium dioxide last. This order permits the handling of the first two powders in a normal manner without having to weigh them inside a dry box kept under a slight negative pressure, as is necessary in handling the uranium dioxide. Ten jars are prepared at a time, then sealed, and a lot number marked on each.

A blending cycle assures a homogeneous mixture of the fuel, burnable poison (boron carbide), and matrix material. All ten jars are loaded in a cylindrical steel container, with padding between them to prevent breakage. The container, with its axis at a 30-degree angle to the vertical, is rotated for three hours.

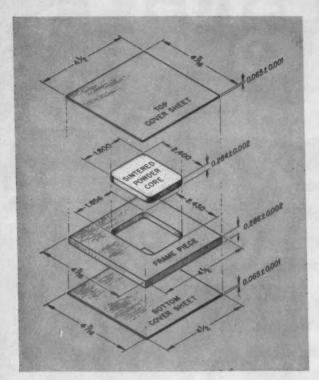
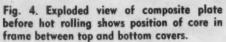




Fig. 5. (Above) In forming the sandwich, the core is first fitted to the frame.

Fig. 6. (Right) Spot welding the covers to the frame keeps sandwich intact while awaiting further processing.



Now thoroughly mixed, the contents of the jars are ready for cold pressing into green compacts. The press used has a hood enclosing its die-bed area. After the ten jars have been placed inside the hood, a slight negative pressure is built up to prevent any human ingestion or inhalation of the finely divided uranium dioxide.

In the heading illustration, the operator is shown emptying the blended powder into the die cavity after having previously applied a lubricant (carbon tetrachloride and stearic acid) by brush to the cavity surface. Rubber-glove ports are built into the hood window, enabling him to perform the necessary manipulations safely. In transferring the powder to the cavity, extreme care is taken to assure that every gram is accounted for, even to the extent of cleaning out the inside of the blending jar with a brush.

After the powder is leveled with a spatula, the press is cycled. A pressure of 33 tsi (tons per square inch) for a fifteen-second interval produces a green compact approximately 0.310 inch thick. The charges in all ten blending jars are pressed, then the compacts are loaded in a stainless-steel transfer box which is closed and taken out of the hood.

During the entire processing, records of the uranium-dioxide lot numbers and positive identifications of the individual fuel plates are mantained. This assures complete quality control, metallurgy history, and accountability for the fuel and burnable poison in both accepted and rejected material. Because the enriched uranium





Fig. 7. After reheating in furnace, the plate is returned to the hot-rolling mill for next pass.

(U-235) content of the finished fuel element must be predicted within 1 gram, in-process weighing takes place following the compacting. A deviation of 0.25 gram from the charged weight for each core is the basis for rejection.

For sintering, the compacts are stacked in a boat and placed in a furnace which has first been purged with dry hydrogen. The boat remains in the furnace, which has an Inconel muffle, for an hour and a quarter, at a temperature of 2150 degrees F. Then the boat is moved to a cooling chamber—an extension of the muffle—where it is allowed to cool to 450 degrees F. (still in the hydrogen atmosphere), and finally air-cooled to room temperature.

To be coined, the compacts are returned to the compacting press. Since the sintering has produced a certain amount of shrinkage, the work is readily located in the same die set. As in the initial compacting, a pressure of 33 tsi for fifteen seconds is used, and produces a compact of the required density and size.

The sintered core is now ready for insertion in a frame, which in turn is enclosed by top and bottom covers. An exploded view of the various components appears in Fig. 4. Covers have previously been cold-rolled from 0.078-inch stainless-steel sheet to a thickness of 0.065 inch; and the frame is cold-rolled from 5/16-inch stainless-steel plate to a thickness of 0.286 inch. Both are sheared to a size of 4 1/2 by 4 7/16 inches, and the frames are then blanked out to receive the core.

Just before the assembly is made, the inner surfaces of the covers and both surfaces of the frame are thoroughly cleaned with a power-driven wire brush. Fig. 5 shows the components being assembled to form a sandwich. One edge of one of the cover plates is marked with a grease

pencil for orientation during the subsequent hot rolling.

To keep the assembly intact while awaiting further processing, the cover plates are now spotwelded to the frame, Fig. 6. Four small spot welds are made, one near each edge. Then, before the hot rolling, the covers are "tig" (tungsten inert gas) welded to the frame, to prevent any shifting of the components. The four corners are left unwelded so that any entrapped air or gas may escape. Also, a small projection is welded at the point of the grease-pencil marking, to identify the rolling direction.

The billets, as these sandwich-like assemblies are now called, are locked up in a safe while they await hot rolling. Security, criticality, and accountability regulations dictate careful control during storage. The shelves of the safe are lined with cadmium. A maximum of thirty billets or plates (billets already rolled into plates are also stored here) may be stacked in one pile on a shelf. There must be a space of at least 4 inches between the piles. To prevent oxidation, the safe has a vacuum dessicator.

The hot rolling, which transforms the billet into a rectangular plate, is performed in a series of ten passes. After the final pass, the plate has a thickness of 0.040 inch, ± 0.002 inch. Billets are hot-rolled in lots of four. A hydrogen-atmosphere electric furnace heats the work to 2150 degrees F. for at least twenty minutes before the first pass. Between each subsequent pass, the work is returned to the furnace and reheated for at least two minutes.

In Fig. 7, a plate can be seen on its way for another pass through the rolling mill (left) after being reheated in the furnace (right). The mill is of two-high design, with 16-inch-diameter by



24-inch-wide rolls. One man feeds the mill, and a second man (partly visible on the other side) grasps the work and rapidly returns it to the furnace.

All four work-pieces in the lot are passed through the mill in succession, after which the center distance of the rolls is decreased for the next reduction. Between each pass, the work is rotated about its long and short axes. Following the fourth pass, the next lot of billets is put in the furnace for preheating; in this way, the hot rolling is virtually continuous. After the final pass, the work is returned to the furnace for a five-minute anneal, then allowed to cool in air.

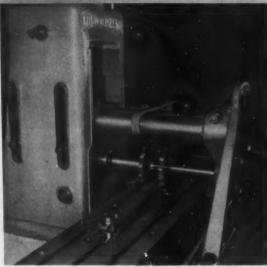
During the rolling, the core material in the center of the plate can be distinguished from the wrought stainless steel around its borders by the difference in the heat color. As the plate becomes elongated, a greater length of wrought material than is required accumulates at the ends. This is removed, usually after the sixth and eighth passes, by a hand guillotine shear located near the mill. A minimum of 4 inches of the inactive material must remain at each end after shearing.

When the plate emerges from the mill, it is not always straight, but may have developed a camber, or bow, to one side, due to an improper feeding of the plate into the rolls, or to an out-of-parallel condition of the rolls. If severe, the camber can cause rejection of the plate, since subsequent trimming would leave insufficient inactive material (stainless steel) along one edge. If the camber is not too severe, it usually can be corrected by feeding the plate into the rolls at a slight angle in the next pass.

Following hot rolling, the plates are fluoroscoped to disclose any internal defects and to delineate the fuel-bearing core area. It is necessary to outline the exact position of the core

Fig. 8. (Left) Feeding a plate to the cold-rolling mill to establish final thickness.

Fig. 9. (Below) After being fluoroscoped to delineate the core area, plate stack is straddle-milled to width.



within the plate, so that subsequent shearing and milling of the edges to establish final dimensions will leave the core located centrally. This is done by scribing lines with the aid of a template which is placed over the core while the plate is still in the fluoroscope machine. Scribed dimensions for shearing are 3 1/2 inches by 27 1/2 inches.

Plate edges are trimmed individually on a mechanical shear, then pickled in an acid solution until all scale is removed. Thoroughly rinsed of all acid, the plates are ready for cold rolling to a final thickness of 0.030 inch, \pm 0.001 inch.

In Fig. 8, a fuel plate is shown being fed into the cold-rolling mill. This is a four-high mill, with 5-inch-diameter by 14-inch-wide work rolls. Plates are handled in lots of twenty, and are reduced in thickness a maximum of 0.001 inch per pass. The final 0.002 inch of reduction may require up to four passes.

Before each pass, the plate is dipped in a heavy lubricating oil which is later removed in a kerosene bath followed by vapor degreasing. As the plates emerge from the rolls, they are checked against a straightedge for camber. Needed correction can ordinarily be made by feeding the plate at a slight angle on the next pass. Every twentieth plate is then radiographed to determine the homogeneity of the uranium dioxide.

In reducing thickness, the cold rolling increases length and width, so the plates again have to be

Fig. 10. (Right) Before flatten annealing, plates are sprayed with levigated alumina.

Fig. 11. (Below) Liquid cement being applied with a hypodermic needle keeps braze powder in place when in furnace.

fluoroscoped to delineate the core area, and again have to be scribed and sheared, in a procedure similar to the one followed after hot rolling. Final width, 2.778 inches ± 0.002 inch, is established by straddle milling, Fig. 9. Plates, in lots of twenty-five, are stacked in a fixture having aluminum-padded clamping surfaces. A pair of 8-inch-diameter cutters climb-mill the two edges.

Final lengths, 23 inches \pm 1/16 inch (for the short plates) and 27 inches \pm 1/16 inch (for the long plates) are obtained on a vertical milling machine. A 4-inch-long plain mill is used. The plate stack is clamped over a block, and each end is milled in sequence. Degreased, the fuel-plate edges are deburred by hand filing.

After a final fluoroscopy with templates for checking length and width, surfaces are examined for defects. Pits or scratches deeper than 0.001 inch are cause for rejection, as are any dents, blisters, or discrete color change between the active core and the inactive stainless-steel material.

Before the plates can be assembled into a fuel element, they must be flat and fully annealed. Both conditions are obtained in a combined "flatten annealing" heat-treating operation. Plates are handled in stacks of twenty-five, which are clamped together in a fixture consisting of an upper and a lower platen. To prevent sticking,



a coating of a solution of levigated alumina is sprayed on one side of each plate, Fig. 10. Stacked and clamped tightly in the fixture, the plates are dried in an oven at 330 degrees F. for a minimum of sixteen hours.

The flatten annealing is performed within an Inconel muffle inserted in a furnace having silicon-carbide resistance elements. Before being loaded, the muffle is purged with helium.

Furnace temperature does not exceed 570 degrees F. at loading; then it is raised slowly to 1200 degrees F., at which point the helium atmosphere is replaced by hydrogen. Furnace temperature is again raised slowly, to 2100 degrees F., held for two hours, and finally dropped to 570 degrees F., when the hydrogen is purged with helium. After the stack has been allowed to cool in air, it is disassembled, and the fuel plates are scrubbed with a brush under flowing water to remove the alumina.

The fuel plates as such are now completely processed, and are ready for assembly and brazing with side plates and combs into fuel elements. Both the side plates and the combs are produced of 0.050-inch stainless-steel sheet. Both are machined to length and width, then eighteen slots are milled into each to accommodate the fuel plates. In addition, the side plates undergo a flatten annealing similar to that of the fuel plates. Immediately prior to assembly, the various components are degreased and visually inspected to assure cleanliness.

The fixture in which the fuel element is assembled is a channel built up of a series of U-shaped supports which are lined with shim pieces on each side. Since the work remains in the fixture through the furnace brazing operation, the supports and shims are made of a grade of stainless



steel which exhibits expansion characteristics similar to the fuel element.

During assembling, Fig. 11, the fixture is supported on trunnions so that it can be readily tilted at a convenient angle. First, two side plates, with slots facing each other, are positioned next to the shims. Then a long fuel plate is inserted from one open end of the fixture and fitted into the bottom slots of the side plates.

Next, with the fixture tilted, a ribbon of powdered braze metal is laid along the point of the fuel plate with one of the side plates. (The powder, a nickel-base alloy, is dispensed from the pencil gun seen on the table.) To keep the powder in place, the fillet is covered with a liquid cement, applied by a hypodermic needle, as is being done in the illustration. Once the cement sets (in about thirty seconds) a "stop-off" is brushed along the fuel-plate area adjacent to the fillet. This prevents the braze metal from flowing onto the active section of the plate during the subsequent brazing.

To apply the powder, cement, and stop-off to the joint of this fuel plate with the other side plate, the fixture is tilted in the other direction, and the procedure is repeated. The sixteen intermediate short fuel plates and the top long plate are positioned in turn in their respective slots in the side plates. Both joints of each plate are prepared with the powder, cement, and stop-off, as are all the joints of the plates with the combs, one of which is positioned at each end.

Assemblies are brazed in the same furnace used for flatten annealing. Before placing the fixture in the muffle, a thermocouple is attached to each end of the element and is threaded through the furnace door. Also, a three-ply, stainless-steel baffle is placed on top of the fixture and a pair of stainless-steel reflector shields is placed in

front, to minimize temperature gradients during heating and cooling. Loading temperature is 570 degrees F.

When the temperature is raised slowly to 1200 degrees F., the initial helium purge is ended, and dry hydrogen is introduced. Once the temperature rises above 2000 degrees F., readings are taken of both thermocouples every minute. Temperature gradient is maintained as low as possible. At 2071 degrees F., the furnace is shut down, cooled to 570 degrees F., and purged with helium. Fig. 12 shows a fuel element in its fixture being extracted from the furnace and allowed to cool in air. (Exactly how the powdered braze metal liquefies and then solidifies around the joints can be seen in Detail D of Fig. 2.)

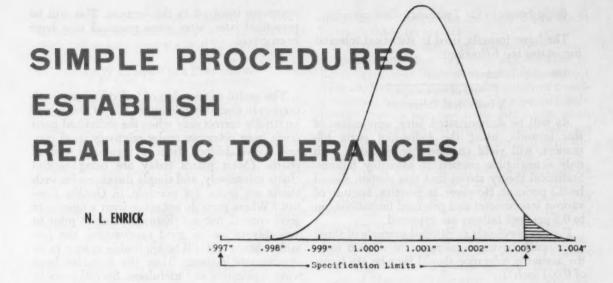
Each completed assembly is marked for identification, then undergoes extensive checking of squareness, plate spacing, element width, and sag or distortion of the top and bottom plates. It is then brought to a milling machine and both ends are squared with a side cutter.

The end boxes, which locate the fuel elements in the grid plates of the reactor core and direct the coolant flow along the plates, are stainless-steel castings. They undergo a series of preparatory machining operations, then are butt-welded to the ends of the fuel element's two side plates. Over-all length of 33 5/8 inches is obtained by milling the ends of the boxes.

The inlet end box is cross-drilled for a dowelpin, which is then inserted and staked. This pin facilitates the handling of the element during its installation in the reactor. A retaining hole for the spring on the outlet end box is drilled and countersunk, and the spring, seen in Fig. 2, is attached. Following a final inspection and degreasing, the fuel element is sealed in a plastic sheath and prepared for shipment.



Fig. 12. Removing assembled fuel element from furnace following brazing operation.



MACHINERY brings you, in three simple, straightforward articles, the down-to-earth essentials of how to apply statistical tolerancing and why it works so well in practice.

The author, Norbert Lloyd Enrick, is known to many of our readers from his book Quality Control, a simplified guide to practical application of statistical control, now in its fourth edition. This book is based on consulting and installation experience in more than a hundred manufacturing plants. The articles presented are an abbreviated and condensed version of the material on statistical tolerancing forming a part of the 1960 edition. This material should provide the reader with sufficient understanding to apply statistical tolerancing to his own manufacturing problems.

STATISTICAL TOLERANCING is one of the most interesting and important techniques on the modern industrial scene, allowing the use of more realistic tolerance combinations than could otherwise be achieved. Improved product and reduced manufacturing costs have been shown to result from proper application of this technique which will be explained by means of relatively simple but nevertheless complete examples.

Suppose we are manufacturing three gears of 1-, 2-, and 3-inch face widths, respectively, the gears to be assembled next to each other on a

transmission case shaft. If the over-all length of the assembled gears must be held within a tolerance of ± 0.018 inch, must the tolerance on the width of each of three gears be held to ± 0.006 inch or can a larger tolerance be permitted?

The answer given to this question depends, among other things, upon the background of the person of whom the question is asked. A novice in manufacturing practice might say, "To be absolutely sure the assembly will not exceed the ± 0.018 -inch tolerance, it is necessary to add the tolerances on the individual widths; therefore, ± 0.006 is the largest tolerance we can afford to give the individual parts since $3 \times \pm 0.006 = \pm 0.018$."

On the other hand, a more experienced observer might say, "It seldom happens that three different parts are all at their maximum (or minimum) dimension at the same time and it is therefore probable that a tolerance greater than ± 0.006 can be applied to each part without exceeding the assembly tolerance of ± 0.018 inch."

It may be seen from these replies that the novice is disregarding extra manufacturing cost and playing 100 per cent safe by specifying a tolerance of no more than ± 0.006 inch, while his more experienced friend is willing to gamble that most of the time a tolerance greater than ± 0.006 inch will not result in more than ± 0.018 inch in the assembly.

However, this latter viewpoint still leaves unanswered the query "How much more than ±0.006 inch can the tolerance be?" It is the purpose of this series to provide some of the answers to this kind of question.

Basic Formula for Tolerance Combination

The basic formula, used in statistical tolerancing, states the following:

Assembly Tolerance =

As will be demonstrated later, application of this formula, using the individual parts tolerances, will yield an assembly tolerance with only a negligible portion of assembly failures. Statistical theory shows that this portion should be 0.3 per cent. However, in practice, because of various inaccuracies and practical limitations, up to 0.5 per cent failures are expected.

For the previously mentioned example of three gears, each having a tolerance of ± 0.006 inch, the assembly tolerance should thus be (in terms of 0.001 inch):

Assembly Tolerance =
$$\sqrt{6^2 + 6^2 + 6^2} = \pm 10.4$$

Since the tolerances for the individual parts are all alike, we can simplify:

Assembly Tolerance =
$$\pm 6 \times \sqrt{3} = \pm 10.4$$

The $\sqrt{3}$ corresponds to the number of individual parts. Thus, if there had been four parts, we would have had:

Assembly Tolerance =
$$\pm 6 \times \sqrt{4} = \pm 12$$

We may now return to our original question. Assuming that the over-all tolerance of the assembled gears is ± 0.018 inch, what is the allowable tolerance for each of the three individual gears? By reversing our assembly tolerance formula, we find the individual parts tolerance. In particular:

Part Tolerance = Assembly Tolerance
$$\div$$
 $\sqrt{\text{No. of Parts}}$

For the example at hand, therefore:

Part Tolerance =
$$\pm 18 \div \sqrt{3} = 10.4$$
 in 0.001 inch

This answers our original question, and also indicates that statistical tolerancing permits wider, and therefore more economical, parts tolerances than simple addition of individual tolerances. We have not yet shown why this formula is valid. The validity could be established simply by pointing to the growing number of manufacturing organizations who are using this technique successfully in their tolerance work. However, the reader who likes to think for himself will want a demonstration of the soundness of the

reasoning involved in the formula. This will be presented later, after some practical uses have been given.

When Will the Formula Work?

The useful relationship of individual parts tolerances to assembly tolerances, shown above, will be strictly correct only when the individual parts come from processes under relatively good control, as established from a review of control charts. (Most plants today are using control charts extensively, and simple directions for such charts are given, for example, in Quality Control.) Where parts do not come from a process in good control, but are thoroughly mixed prior to assembly to assure good randomness, the formulas shown will still be applicable at least in an approximate manner. Thus the formulas have wide application and usefulness. Special cases in exception of this general rule will be discussed later.

Further Tolerancing Examples

We will demonstrate the use of the tolerancing formulas in several further applications:

1. Electrical Resistance. In the assembly in series of four resistances, each having a tolerance of 3 Ohms, the resultant combined tolerance is $3 \times \sqrt{4} = \pm 6$ Ohms.

2. Tolerances for Weight. An airborne component, consisting of fourteen parts, had the following tolerances:

a. Three parts with tolerance of \pm 6 oz. each;

b. Five parts with tolerance of ± 8 oz. each;

c. Six parts with tolerance of \pm 4 oz. each. The assembly tolerance is now:

Assembly Tolerance =
$$\sqrt{(3 \times 6^2) + (5 \times 8^2) + (6 \times 4^2)}$$
 = 22.9 ounces.

3. Plastic Coating Operation. This example illustrates how the tolerancing formula can also use subtraction, in place of addition. In this particular case, the tolerance for a thin-coated material was \pm 5 tenths of an ounce. The uncoated material could be produced to a tolerance of \pm 4 tenths of an ounce. Therefore, the tolerance for the coating operation is:

Coating Tolerance =
$$\sqrt{5^2 - 4^2} = 3$$
 tenths of an ounce.

Originally, it had been thought that the tolerance for coating would have to be \pm (5–4) or \pm 1 tenth of an ounce, using simple subtraction. This, however, would have been unattainable in processing. Analysis by means of the statistical

tolerancing formula above showed the manufacturer that he could undertake this particular work and readily meet the final tolerance of \pm 5.

The Old-Timer's Objections

The approach to tolerancing shown in this article, using the computation steps borrowed from Analysis of Variance technique, is relatively recent in industry. It has been a natural outgrowth of the use of statistical control charts and related analysis tools. As a matter of fact, the use of the statistical tolerancing approach shown here presumes statistically controlled processing. The rewards for this care and statistical study come in the form of individual tolerances that can be permitted to be wider than otherwise possible, without detracting from the quality of the finished product. This saves production costs. Moreover, when these techniques are used in analyzing fits and clearances, it can often be shown how tolerances can be widened and quality improved at the same time.

The old-timer, however, who has used the conventional additive methods of tolerance accumulation, may well question our procedures, arguing as follows:

"In the example of tolerance accumulation of three individual parts, each being allowed limits of plus or minus 6 thousandths, you used a formula whereby the final assembly would be expected to be within plus or minus 10.4. Yet, if three parts of plus 6 or three parts of minus 6 are combined, the limits will become plus or minus 18. This is a lot wider than the plus or minus 10.4 from your formula. Therefore, if parts

are at their extremes, the assembly limits would be wider than you predict."

It is true, of course, that when the extremes happen to come together, they will assemble to limits in excess of those given by the square root formula. However, under random assembly such a meeting of extremes may be expected only rarely. After all, extremes form only a very small portion of a bell-shaped frequency curve, and one cannot expect that these few parts will normally meet in assembly. A few such adverse combinations will of course occur. Where distributions are normal and assembly is at random, there will be about three out of every thousand assemblies where the statistically determined tolerance is exceeded in assembly. In practice, due to various inaccuracies and imperfections in requisite conditions, the actual occurrence of assembly failures may be several times greater than the theoretical 3 out of 1000 or 0.3 per cent. Usually, however, this presents no real problems in production, since the operator can break up the adverse combination by simply exchanging the extreme piece picked up last for another random piece from the

While the idea of statistical tolerancing was considered quite revolutionary only a few years ago, there are many plants today that find these techniques essential for their work. It is of course the responsibility of the statistical tolerancing committees in manufacturing plants to recognize those conditions where the prerequisites for the tolerancing formula are not fulfilled, and instead the conventional additive or other procedures must be used. This will be discussed at the conclusion of the next article.

X-ray head of a continuous fluoroscoping inspection unit is shown here inside a section of welded-steel pipe at United States Steel's National Tube Division, McKeesport, Pa. A fluorescent picture of the weld is transmitted to a television screen inside a booth, permitting an inspector to check the entire length of the weld in large-diameter pipe.





HAROLD W. BREDIN Associate Editor

Advanced Electronic Systems Need Versatile Metalworking

High-frequency electronic equipment and electromechanical missile guidance devices require many unusual and precise components. Versatile metal-working techniques help ITT Federal Division to build some of the country's most highly developed electronic systems

PRECISION and VERSATILITY enable the production facilities of ITT Federal Division, Clifton, N. J., to keep pace with the fast changing requirements of the electronics industry. This division, the largest of the International Telephone and Telegraph Corporation engaged in manufacturing, makes advanced electronic and electromechanical equipment for defense, communications, and industry.

Increased use of microwave propagation and receiving devices has led to a greater need for close tolerances on purely electronic components. In addition, high-precision parts are required in electromechanical systems made by the com-

pany for use in missile guidance equipment and for many other applications.

Electronic systems must often be built in small quantities and completed in limited periods of time. This is particularly true of highly specialized equipment made for national defense programs. Components for electronic systems are designed in a wide variety of both simple and complex shapes and are composed of materials ranging from soft plastics to difficult-to-machine metals such as Invar. Efficient and economical manufacture of a number of these parts in short-run quantities is accomplished through some unique applications of versatile equipment.

Tracer-Controlled Milling Makes Short Work of Many Short-Run Jobs

One example concerns the milling, contouring, and boring of an aluminum support plate for gear bearings. The plate, which is employed in a servo drive mechanism, requires four contoured slots and a number of accurately bored holes that receive antifriction bearings. Two accurately located angular side surfaces are also milled on the part.

All of these operations are done on a single

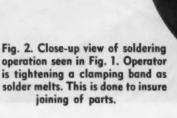
Gorton vertical milling machine (seen in the heading illustration) which is equipped with three-dimensional hydraulic tracer control. The True Trace control system used is not an attachment but an integral part of the machine.

In the illustration, the operator is shown directing the stylus over one of the two angular side surfaces of a specially prepared master part. Finger-tip pressure on the stylus controls the direction of the work-piece and master in relation to the cutter during milling. All table feeds are synchronized and controlled by a single selector

lever. The result is a constant feed rate independent of the pressure on the stylus. In addition, the feed rate can be increased or decreased while the machine is in operation. To mill the angular side surfaces, the valve for the vertical hydraulic control circuit is closed, effectively changing the setup into a two-dimensional tracing system. The four contoured grooves are machined with the same cutter while the part is still in the setup. A fixture is used to locate the work-piece in the proper relation to the master. Both side surfaces and the four contoured holes can be machined in four minutes.



Fig. 1. Here, a beryllium-copper spring contact strip is being induction-soldered to a high-frequency component employed in a missile guidance system.



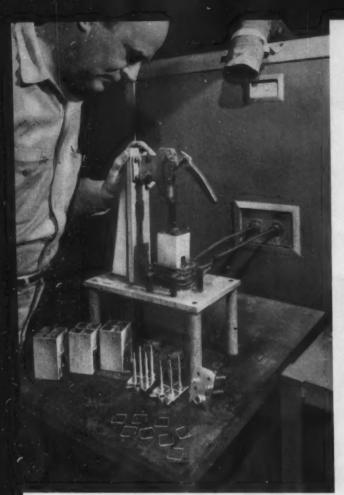


Fig. 3. These preselector units are assembled with three types of solder, initial joints being made with high-melting-temperature solder. In the final operation seen here, preformed soft solder is used.

The accurately bored holes are produced in a second operation. To prevent wear, the holes in the master have hardened steel liner bushings. (This is also true of the contoured grooves.) Whereas in the contour and side milling operations the stylus and cutter diameters were maintained in a 1-to-1 ratio, a single-diameter stylus is used to locate all of the three sizes of bored holes required. In this case, the stylus is simply used to accurately locate the holes in relation to each other.

When the holes are bored, the milling cutter is replaced by a stepped boring tool capable of producing the three required diameters. Since the cutter is made of carbide and the part of aluminum, wear of the tool is held to a minimum. A special stylus is employed which is lapped to accurately fit the bushings in the master part.

In operation, the stylus is manipulated into perfect alignment with the holes in the master. In this position, the master can be fed upward over the stylus, causing the cutter to bore the work-piece. The size of each hole depends only on the portion of the cutter that is permitted to engage the work. Center-to-center distances be-

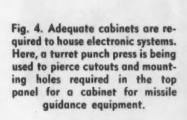






Fig. 5. Welding a stiffener to the side panel of a cabinet for electronic equipment. The inert-gas shielded method employed produces a clean weld.

tween the holes can be held to within a tolerance of 0.001 inch and the diameter of the bore to within 0.0005 inch.

According to the accuracy and shape of the part, the master may be a specially prepared piece, a completed part, or an inexpensive sheetmetal template. When cutting a contour in three dimensions, a ball mill and a matching stylus are employed. In many instances, plates for mounting electronic equipment in cabinets require odd-shaped counterbores. These are readily produced from sheet-metal templates with this equipment. The machine has spindle speeds of from 250 to 6000 rpm and the feed rate can be varied from 0 to 40 inches per minute. A hand feed on the spindle permits setting of the cutter height and the tracer unit is mounted on a compound slide, allowing adjustment of the stylus position in relation to the machine spindle.

Induction Method Simplifies Soldering of Precise Electronic Assemblies

High-frequency electronic equipment contains many soldered components. The accuracy to which these parts must be made can only be assured if the heat employed in soldering does not cause distortion. Induction soldering is employed on most electronic equipment. This method allows easy control of the temperature and even distribution of the heat in the soldering area. The induction coils instantaneously apply the heat where it is required.

In Figs. 1 and 2, the Lepel induction-heating equipment is shown being used to solder a beryllium-copper spring contact strip to an Invar plunger for a high-frequency cavity employed in a missile guidance system. The operator is tightening a clamping strap to take up the differential

expansion as the solder flows. The diameter and position of the spring contact strip must be accurately maintained since the tension of the contacts on the mating component is important. For even heating, the heating coil, which is water-cooled, must be centrally located in the plunger and aligned with the solder joint. A soft solder wire which melts around 450 degrees F. is used. Induction heating prevents excessive tarnishing of the joined parts, both of which have been silver-plated for a functional reason prior to soldering.

Another example of induction soldering is shown in Fig. 3. There, a high-frequency preselector unit, which is assembled in a number of stages with three types of solder, is shown set up in a clamping fixture for the final operation. The three inserts that can be seen on the base of one of the incompleted parts are first silver-soldered in place, using a silver solder that melts at 1400 to 1500 degrees F. Each of the four inner conductors is then silver-soldered to the upper side of the base with a solder that melts at 1275 degrees F. This is done so that the previously soldered joints would not be melted during the operation.

A group of four rectangular sleeves, which have been soldered together, are then joined to the base with a soft solder that melts at about 450 degrees F. In this final soldering operation, four preformed solder squares are slipped in place and the sleeves or cans are held against the base by the clamping fixture as shown.

To illustrate some of the tolerances that are maintained, the contact fingers which are on the four inner conductors must be held within plus 0.010 minus 0.000 inch in height and plus or minus 0.005 inch in concentricity. This is to insure that the proper contact pressure is applied





to the mating parts. After each soldering operation the parts are given a bright dip for cleaning.

Electronic Systems Require
a Wide Variety of Metal Cabinets

All electronic systems are housed in some form of cabinet ranging in size from large consoles in heavy-gage aluminum or steel to small, light-weight units. Many cutouts and holes for mounting special dials and instruments are required. To facilitate this work, turret type punch presses are employed. In Fig. 4, a Wiedemann twenty-eight-station turret punch press equipped with a pantograph arrangement is shown being used to make three cutouts and punch a number of mounting holes in a panel. The work-piece is the top panel for a cabinet designed to house ground-to-air missile guidance equipment.

In the operation, the panel is first clamped to a cross-slide on which the pantograph stylus is mounted. A color-coded system of holes in a template secured to the machine table behind the cross-slide is used to position the stylus and the work-piece for each punching operation. The holes in the template associated with each color system are for locating all the holes in the work-piece to be made by a single punch.

When the stylus is positioned in each template hole, the punch in the operating position automatically pierces the work. Thus, as the stylus is moved from hole to hole in each color system, the work-piece is automatically positioned and punched. After punching each group of holes, the turret is rotated to the next operating position by a handwheel at the front of the machine. Five

Fig. 6. (Top) Master gage-blocks are calibrated against the wave lengths of the emission spectrum of helium and krypton to plus or minus 0.000002 inch in this Koester's absolute interferometer.

Fig. 7. (Center) Here, a ring gage is being checked in the standards laboratory for roundness, diameter, and taper on a Perflectometer. Measurements are made by comparing the part to an optical scale.

Fig. 8. (Right) This surface plate, made of California granite, is being checked for flatness with an auto-collimator.



Fig. 9. The form of threads on plug gages is optically compared against a master template by means of this toolmaker's microscope.

punch stations (and color codes) are used in processing the panel shown in the illustration at the rate of five minutes per panel. The large cutouts are produced by a series of overlapped piercing operations made along the periphery of the hole. Dial verniers can be used to facilitate positioning of the work-piece when a template is not used.

Whether made of aluminum or steel the cabinets are largely of welded construction. Inertgas shielded arc welding which produces clean, slag-free welds is seen being used to attach stiffeners to a cabinet side panel in Fig. 5. The operator staggers the initial tacking welds along the sides of the stiffeners to prevent distortion of the work. Both the stiffeners and the panel are made of 1/8-inch thick hot-rolled steel that has been pickled in oil to prevent corrosion. The 140-ampere welding current is supplied by an Airco Heliwelder, and the inert gas employed is argon.

A Well-Equipped Standards Laboratory Serves the Company

A unique laboratory located within the physical confines of the company's plant is devoted to the checking of master mechanical and electrical measuring devices. Known as the ITT Standards Laboratory, these facilities also make their services available to private industry, universities, scientific foundations, and U. S. government agencies.

The mechanical measurements section of the laboratory is supported on an inertial block of concrete which is isolated from the floor of the shop facilities by a vibration absorbing material. Within the laboratory, the temperature is maintained at 20 degrees C. and the relative humidity, at 48 per cent. Filtered air is supplied at a positive pressure with respect to the outside air to prevent dust from entering the facilities. Persons entering the laboratories must first pass through a delinting room in which blasts of air remove dust and other particles from their clothing.

A Koester's absolute interferometer made by Carl Zeiss is used to establish the size of master blocks to an accuracy of plus or minus 0.000002 inch. This equipment, shown in Fig. 6, employs wave lengths in the emission spectrum of helium and krypton as standards for comparison. Barometer, thermometer and psychrometer readings must be taken as the wave length of light in air varies with these physical properties. Surface fin-



ish of gage-blocks is measured on a Carl Zeiss Opton interferometer microscope. These master gage-blocks are then used to check working gage-blocks to within plus or minus 0.000001 inch through the use of a Pratt & Whitney Millionth Comparator. Flatness of working gage-blocks is disclosed by examination with an optical flat under monochromatic light.

Ring gages are checked for roundness, diameter, and taper on the Leitz Perflectometer seen in Fig. 7. This device, which employs two microscopes, optically measures the gage against an accurately calibrated scale. It measures roundness, internal and external surfaces, linear dimensions, and taper of holes to within plus or minus 0.00004 inch. A Kodak optical comparator is used for checking surfaces and contours under magnifications up to 100×. In Fig. 8, an auto-collimation setup is being used to check the flatness of a California granite surface plate.

When inspecting threaded plug gages, the pitch diameter is first checked over wires on a Pratt & Whitney standard measuring machine to within 0.00001 inch. Pitch inaccuracies of less than 0.0001 inch are then determined on Sheffield lead-measuring equipment. In a final test, the Leitz toolmaker's microscope seen in Fig. 9 is used to compare the thread shape against a master template. Other test instruments in the laboratory include a Leitz optical dividing head, surface roughness measuring equipment and various hardness testing devices.



EVERETT M. HICKS, Vice-President and General Manager Machine Tool Division The Norton Co., Worcester, Mass.

1050 WAYS TO CUT COSTS

THE MACHINE TOOL EXPOSITION—1960, to be held on September 6 to 16 in Chicago, will, in my opinion, constitute the most important single industrial event of the present decade. You may think that this is merely an exaggeration, naturally to be expected of a machine tool builder. Such is not the case. Consider the following:

In the International Amphitheatre, spread over well-nigh 12 acres of floor space, will be displayed 1050 ways to cut costs in the form of 1050 of the very latest American-built machine tools.

That's one fact.

In foreign countries, especially those of western Europe, there is under way a great industrial resurgence, founded upon a combination of plant modernization and wage rates much lower than those in this country. That's another fact. Now let's relate those facts to each other.

The New Competitive Picture

From the standpoint of economics, the function of machine tools is that of increasing productivity; or, as we say traditionally in the industry, "providing better things for more people at lower cost." In a competitive economy such as ours, it is the never-ending drive to reduce costs that underlies the continuous program of research and product development which is always going on in the machine tool field.

If the nation is to survive, we must somehow contrive to arrest inflation. The way to stop prices from going up is to get costs down. Developments in machine tools therefore have a direct bearing upon the nation's financial stability.

Up until comparatively recent times, the economic pressure for cost reduction has reflected chiefly domestic competition. But in recent years there has been accelerated competition from abroad. Nations such as England and West Germany, which our foreign aid program helped put back on their feet after World War II, have not only achieved recovery but have mushroomed into unparalleled industrial growth. Many of

their plants are new—newer than ours. In West Germany, for example, the percentage of obsolete machine tools still in use on factory floors is far lower than is the case in the United States.

Meanwhile wage rates abroad remain far below those in this country. An example from the machine tool industry will serve as an illustration. The average rate for production workers in the United States machine tool industry, exclusive of fringe benefits, is about \$2.40 per hour. By contrast, the rate in France is approximately \$1.00; in England, 85 cents; in Germany, until recently, 60 cents; and in Italy, 35 cents.

Industrialization is well under way in many parts of the world, such as India, where not so many years ago practically all manufacturing was done by hand. It is doubtful whether the rate of industrial expansion in France and Italy today is as rapid as that in Communist China. And Russia is threatening to build an industrial empire with the announced objective of putting the West out of business.

With low wage rates, modern plants, and increasing capacity, the rest of the world is getting set to move in on the domestic markets of the United States. They can undersell us here at home because their costs are lower than ours; and unless we in this country can get our costs down so that we are competitive, the future outlook is grim indeed.

Everyone knows what has happened to the textile industry and certain phases of the electrical and photographic industries as a result of Japanese competition. Or, what has happened to the watch industry as a result of Swiss competition. All one has to do is to look at the traffic driving past his office to see what is happening to the automobile industry as a result of foreign competition. The situation is even getting into basic materials. Due to the St. Lawrence Seaway, for example, German barbed wire can be sold in Cleveland, Ohio, at \$40 a ton less than our own.

What will happen if nothing is done to stem

this trend? If carried through to its logical conclusion, the answer will be that basic production in this country will shrivel to a minimum and the major share of production will be done abroad. Products may be shipped to the United States principally for assembly and service. Instead of being the leading industrial producer of the world we may become merely a market.

You may think that this picture is too extreme. Well—no matter what business you may be in, may I suggest that you check up on competitive products available from foreign sources and see what they have to offer in this country—both as

to quality and price.

Imperative Need to Reduce Costs

The inescapable fact is that America's metalworking industry must contrive to reduce costs if it is to survive on its present level. This is the underlying significance of the Machine Tool Ex-

position-1960.

The need is immediate. Is there any likelihood that wage rates will come down in the near future? Is there any likelihood that taxes will come down in the immediate future? There is talk about revision of Internal Revenue Department depreciation policies to provide faster write-offs; but when might this materialize? Are prices of materials likely to decline in the near future?

There are always economies to be gained by better administration and better methods, but such measures are the sort that normally must be taken to keep abreast of domestic competition,

to say nothing of foreign.

Should a company use inferior materials, simplify design at the expense of performance, and turn out a not-so-good product at a lower price? This might have been the old-fashioned way of meeting foreign competition—but it will not work today, for foreign producers in many fields are now turning out products of excellent quality.

The one remaining avenue of cost reduction is greater output per man per hour—in short, increased productivity; which brings us right back again to machine tools and to the Machine Tool

Exposition-1960.

1050 Ways to Cut Costs

How can metalworking manufacturers cut costs to meet competition? This is the problem perpetually proposed to machine tool builders. They must get the answers or go out of business.

The people in the machine tool industry are

therefore extremely sensitive not only to the current problems and requirements of customers, but to the underlying competitive picture which affects the industries they serve. The industry has been keenly aware of the growing impact of foreign competition upon the United States, and all of its implications. The result is that within the machine tool industry, invention and product development have been moving at a steadily accelerating pace. It is no exaggeration to say that more advances in the art of removing metal have been made during the last five years than in the previous twenty.

It is impossible here to go into details—they are too varied and too complex. There have been major strides, of course, in the application of numerical controls; in the design of machines capable of multiple operations; in the devising of automatic devices for loading and unloading; in the development of entirely new processes for removing metal. There have been great advances, too, in the field of accuracy—millionths of an inch are now as common as thousandths used to be.

There is, however, one broad feature which is in the main common to all new developments—namely, the shift from operator control to automatic control. This is a basic change. It means that the rate at which work is done, and the accuracy with which it is done, no longer depend upon the skill and the experience of the operator. Rate of productivity and accuracy are being built into the machine itself.

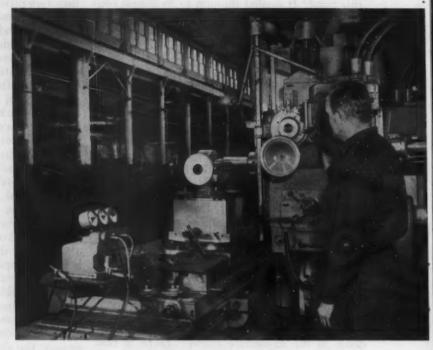
The pace of production is, therefore, determined not by men but by machines. The installation of new machine tools is a means whereby assured increased productivity can be obtained—with resultant reduction in manufacturing costs.

Why a Machine Tool Exposition?

The reason is simple. Machine tools cannot be carried around in a sample case—and neither can all the metalworking manufacturers of the United States afford to visit all the machine tool plants in the United States. The only means whereby it is physically possible for manufacturers to see all of the new machine tools which they ought to see is to put these machines together under a single roof. Many will be entirely new models and all will have new features. Each one has special purposes and potentialities. A visitor to the exposition may study and compare the different machines, ask questions, and find out for himself just which ones best suit the requirements of his own plant.

Making Better Pumps

HAROLD W. BREDIN Associate Editor



Judicious use of modern machining and gaging techniques is helping Worthington's Standard Pump Division not only to improve production but to obtain more perfectly interchangeable pump components

SUPPLYING small- and medium-capacity pumps to modern industry is inherently a highly competitive business. It is even further complicated by the wide variety of sizes, types, and materials in which the products are required. To compensate for these conditions, the Standard Pump Division of the Worthington Corporation, East Orange, N. J., has adopted some unusually versatile machining methods and the latest in in-process gaging techniques. The results have been both improved production efficiency and a higher degree of component interchangeability, so necessary in this field.

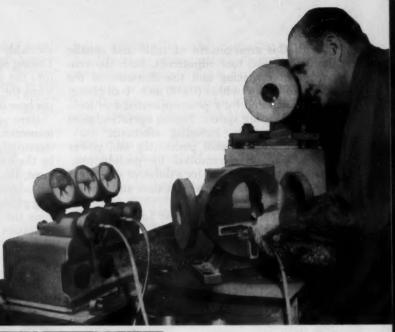
The need to achieve interchangeability through both design and manufacture is illustrated by the fact that the company produces parts for 120 sizes and types of end-suction centrifugal pumps from which 70,000 different pump combinations can be made to the customer's order. This does not include the many rotary and other types of pumps produced and assembled at the plant. Materials for these pumps range from brass to the high-alloy stainless steel "Worthite" employed in many of the company's pumps for handling acids and numerous other potentially destructive fluids for the chemical industry. While many special components are separately machined, high-volume production lines are maintained to provide an inventory of interchangeable parts and sub-assemblies both for replacements and original pump assembly.

Repetitive Precision and Versatile Setups Improve Machining

Interchangeable assembly of parts can only be obtained through precise repetition of machining processes. To attain this goal, bodies and sideplates for various size rotary gear pumps are accurately faced and bored in a single setup on

Faster

Fig. 1. Here, a special pneumatic gaging setup is being used by the operator to check bores in a rotary pump body at the machine.



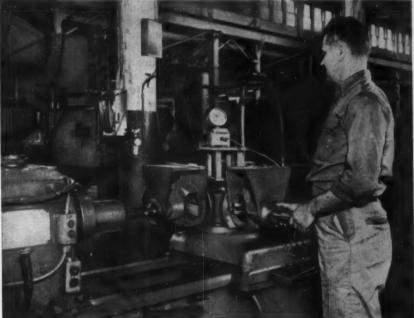


Fig. 2. Pump brackets are fixture-mounted on the tool turret of this lathe for boring. Micrometer adjustment on boring-bar facilitates tool setting and air gage on turret allows rapid inprocess inspection.

the DeVlieg Spiramatic Jigmil shown in the heading illustration. This machine is equipped with a system that can automatically and repeatedly position the spindle head and work-table, within precise limits, to desired settings.

The cast-iron pump body seen in the illustration is mounted on a fixture secured to a rotary table on which the part is accurately indexed 180 degrees between each facing operation. By presetting a combination dial and vernier on an automatic trip mechanism for stopping the spindle-bar feed, the required position of the cutter can be accurately and readily repeated when facing the pump body. The width of the body is held within a tolerance of 0.0015 inch.

A combination of fixed and micrometer-head adjustable gage-rods and specially prepared "Duplitrol" bars serve to guide the mechanism that automatically positions the work-table and spindle head for the boring operations. The two intersecting close-tolerance bores required in the pump body accommodate impeller gears. In boring these holes, the DeVlieg Microbore equipment used employs carbide indexable inserts and has a micrometer vernier adjustment. The latter feature permits rapid setting of the tool.

With this arrangement of table and spindle positioning and tool adjustment, both the center-to-center spacing and the diameter of the bores are held to within 0.0005 inch. Tool changing is facilitated by a power-operated tool locking and releasing system. During operation, most machine functions, including automatic worktable and spindle head positioning and power tool locking, are controlled by push-buttons. Changing a setup to one for a different size pump body or side-plate requires less than an hour.

Air Gaging Equipment Speeds at-the-Machine Inspection

In-process inspection by the machine operator is employed to further guarantee the accuracy of pump bodies. The diameter of the bores is shown being checked in Fig. 1 by a special air gaging unit used in conjunction with a Pratt & Whitney Air-O-Limit comparator. Maximum and minimum size master ring gages are employed to set the tolerance limit readings on the gage. This method of gaging not only enables the operator to quickly check the part but also tool wear.

The unusual application of a turret lathe, illustrated in Fig. 2, is an example of how modern tooling and gaging practices have been adapted to existing shop equipment. In this instance a Microbore boring tool is installed in the spindle of the lathe, and the work-pieces, which are castiron pump bearing brackets, are mounted on the

Fig. 3. Blanks for rotary pump impeller gears are quickly checked for outside diameter, bore diameter, concentricity, and face runout in a pneumatic gaging fixture (left). Multiple-column gage (center) gives simultaneous indications for these measurements.

rotatable tool turret by means of special fixtures. During operation, the brackets are each indexed into the work station and fed by the turret toward the rotating boring tool. The diameter of the bore is held to within 0.0005 inch.

Here again is an example of rapid in-process inspection. As each part is indexed from the work station, the bore diameter is immediately checked by the operator using Sheffield air gaging equipment, the gage being supported in a fixed position above the center of the lathe turret. Master ring gages are also employed in this case to determine the positions of the dial indicator for the maximum and minimum allowable sizes of the bore. At the loading station the brackets are gaged, removed, and replaced before the part in the working station is completed.

Multiple-Purpose Air Gaging Setups Employed

Blanks for the herringbone impeller gears used in rotary type pumps are simultaneously checked for a number of close-tolerance dimensions in the special air gaging fixture seen at the left in Fig. 3. The results, which are instantly shown on a five column Sheffield Precisionaire instrument, indicate the accuracy of the bore and outside diameters, concentricity of bore to periphery, and squareness of the bore to the face. A second gaging fixture for checking the blanks of smaller size pump gears is seen at the right in the illustration. (A completed impeller gear is shown inserted in the smaller fixture instead of a blank.) Master parts used to determine the readings of the instrument that are within tolerance are shown at the right of the larger fixture. Typical tolerances on impeller gear blanks are as follows: outside diameter, plus 0.000 minus 0.001 inch; bore diameter, plus 0.0005 minus 0.000 inch; maximum eccentricity, 0.001-inch total indicator reading: and maximum runout of face, 0.001-inch total indicator reading.

Burrs left on impeller gears when the teeth are cut in the blanks are removed by power brushing. In Fig. 4, an Osborn power brushing machine equipped with dual Tampico brushes is seen being used to deburr a rotary pump impeller gear. Each gear is mounted on a spindle and rotated in contact with the brushes for six seconds at a 5 1/2- to 6-ampere load current. The machine operates in an automatic cycle. In this manner, power brushing uniformly and rapidly deburrs the gears without excessive removal of metal.

Continuous Electronic Gaging Aids Grinding

Surfaces of pump shafts are ground on the Cincinnati Filmatic grinding machine shown in Fig. 5. To facilitate this operation, a continuously



meter calibrated in inches according to the scale amplification (or magnification) employed, and a succession of colored lights flash on to alert the operator as the required size is approached. In the illustration, the operator is checking a pump shaft having a tolerance of plus or minus 0.0002 inch using a magnification that makes each division on the meter scale equal to 0.0001 inch. Actually this shaft is held to within 0.0001 inch of the required diameter.

Four scale magnifications are available to the machine operator: 0.0005, 0.0001, 0.00005 and 0.00001 inch per graduation. Another feature of this equipment is that gage-blocks or other standards are not required to calibrate the instrument. The deflection of the meter is simply adjusted to full scale when the range selector switch is turned to a special calibration position. Continuous elec-



Fig. 5. Continuous electronic gaging employed while grinding the surfaces of these pump shafts helps boost production and quality of work. Scale magnifications up to 0.00001 inch per division are possible with this equipment.

measuring electronic gaging setup engineered by Tri-Seco, Inc., Mt. Vernon, N. Y., is employed. Both the electronic gage and amplifier used are seen mounted on the upper right-hand side of the machine. The gaging unit which remains in contact with the work-piece while it is being ground contains a differential transformer type pick-up head. Voltage changes produced by this head are proportional to the mechanical displacements that cause them and indicate the direction of the displacements.

Measurements are read on a direct-current

tronic gaging has been found to give the operator better control over the size of the work-piece produced.

An easily removed plastic protective coating material is applied to precision-machined parts before they are shipped or placed in storage to await assembly. The parts are simply dipped in a warmed solution of the compound which congeals on the colder part as it is quickly removed from the bath. Everything possible is done to prevent poor or damaged parts from arriving at the assembly area.

"Rubber Tooling" GOES TO WORK

A whimsical tool engineer once could dismiss a blind valve-port design with the cliche that the job called for "rubber tooling." Up until the advent of electrical-discharge machining, machining "around-corners" could not be done without costly drilling and plugging

LAURENCE W. COLLINS, Jr.
Associate Editor

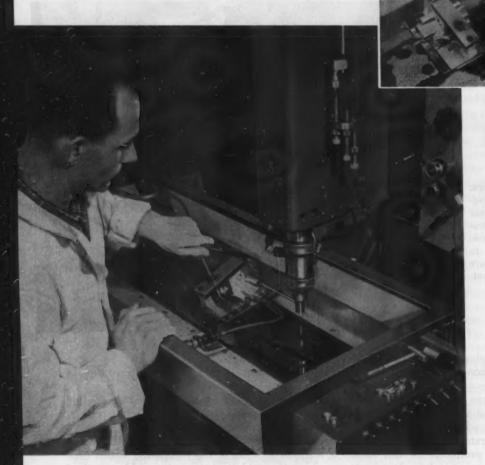


Fig. 1. Electrical-discharge machining setup has a tank built around a milling-machine table so that a dielectric oil submerges the work, quenching the spark and carrying away debris. The work-head has a servo feed.

Fig. 2. Each porting cut requires a new electrode tip. Note the offset positioning of the electrode center line on the horizontal bracket. This provides tool displacement in the undercut when the table has been moved to the left and the work-head begins to feed the electrode to the work.

THE HYDRAULIC CONTROLS for advanced aircraft call for valves having designs that manufacturing engineers call "wild." One typical pressure-operated slide valve has a 0.500-inch-diameter blind bore 4 inches deep on one side of its forged AISI 2024 ST aluminum body. The design calls for accurately recessed undercuts on this bore, and, in addition, requires that rectangular ports be cut all the way through the recess walls into an adjoining cylinder, at right angles to the axis of the bore.

The cut is 0.256 inch wide by 0.480 inch long and tool displacement must be 0.230 inch to complete the port into the adjoining bore. One of the ports is near the bottom of the bore, so that cutting must be done "around-the-corner"—often impossible to reach with accuracy by conventional methods of machining. Today "rubber tooling," to machine "around-corners," is a practical concept, thanks to electrical-discharge machining, as used by Hydra-Power Corporation, New Rochelle, N. Y.

A refinement of "disintegrating," electrical-discharge machining as embodied in the Elektrojet is more than simple metal removal. Rather, the method takes its place beside traditional precision

Fig. 3. Electrode enters the bore. High turbulence in the dielectric oil is required in the spark gap. Therefore the horizontal tool support tube is slotted at the bottom near the electrode to direct a jet of oil into the cut. The stream washes the swarf away.

machine tools because of its proved ability to remove metal under precise control, in previously inaccessible areas. The product is a work-piece of specific geometry with controlled dimensions at specified surface finishes, often machined "around-corners." The Elektrojet is built by Cincinnati Milling Machine Co., Cincinnati, Ohio.

Precise control (achieved by advanced electrical-circuit elements) and improved servo systems have been added to the old "tap disintegrator" method of metal removal to produce a machine tool package capable of efficient and precise work acceptable to even today's aircraft standards. The method is frequently identified by its initials as, simply, "EDM." The first-delivered unit of this modern generation of Cincinnati electrical-discharge machines, Fig. 1, is in daily operation at the Aircraft Products Division of Hydra-Power.

One of the "impossible" cuts it makes on regular production is the blind slotting of the valve ports, Fig. 5, described in the first two paragraphs of this article. The finish-bored valve bodies are clamped in an angle fixture on the machine table. The table resembles that of a milling machine, Fig. 2, except that a steel enclosure sur-

rounds the outside, making a tank. Thus, the work-piece is submerged, during cutting, in a special dielectric oil, Fig. 3. The work-head is mounted on a column in a manner similar to a vertical milling machine quill or jig-borer spindle. Axial feed of the work-head is controlled by an electrohydraulic servomechanism. The machine automatically holds the optimum work-to-electrode spark gap distance of about 0.001 inch. Tool and work never intentionally make contact with each other during the operation.

Stock-removal action is controlled erosion caused by a pulsed electrical discharge across the gap. The low-energy electrical discharges have an ultra-high frequency pulse rate under low voltage. The arc melts and ejects tiny blobs of metal from the work surface. The work and electrode are submerged in a dielectric oil that is circulated at a high rate of turbulence to wash away the eroded debris. The dielectric oil is circulated from a filter-reservoir into the table tank. The oil level can be raised and lowered rapidly. The system has a separate pump for pressure auxiliary flow through the electrode itself. The Elektrojet machine at Hydra-Power Corporation is rated at 15 amperes maximum capacity, adequate for the comparatively light work done by the company.

When making deep displacement cuts, the operator aligns the center line of the electrode and the bore, as in Fig. 3, and moves the table so that the electrode enters the bore. As the undercut areas on the bore move past the electrode the operator can sense the position of the electrode in the blind hole by observing the behavior of the needle of an indicator on the control panel. When the bore is small the needle registers full cutting amperage. But amperage "drops-off" when the electrode is in the area of an undercut where the bore walls are more distant. Thus the operator saves time in finding the cut for the port and also works with greater precision. Once working depth has been located, work-head feed is begun for the displacement cut.

Hydra-Power makes a variety of internal valve parts, Fig. 4, in addition to valve bodies. EDM is effective in making slots or cavities of almost any cross section in any electrically conductive material. These cover the range from aluminum to stainless or hardened tool steel at Rockwell C-62, and certain cemented carbides.

The nature and condition of the work material influences the gap distance, the selection of electrode material, the discharge pulse cycle, and the amperage. The lot size can also affect the selection of electrode material. For example, Hydra-Power's forged aluminum valve body in the illustration, Fig. 5, is one of a run of about fifty pieces. Each cut requires a new brass electrode for a total of about 100 electrodes for the run. While the brass is "something they just happened to have around," the electrode tips must be accurately machined and must be drilled accurately with three holes, one for a fastening screw and two for locating pins. The tip is fastened to the end of a length of 5/16-inch-diameter steel tubing which in turn is held at 90 degrees to the work-head axis. The top of the electrode is held flush with the outside diameter of the tubing.

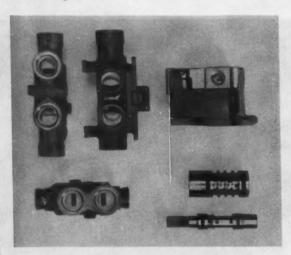
If the part run were ten or fifteen times larger or the electrode more complex, the volume might justify using a special electrode material that would have longer life, thereby lowering tool cost. Using the equipment described, the tooling cost is only half that which would be involved in making special Woodruff cutters for the same job. Furthermore, deburring is eliminated and productivity is higher.

This same electrical-discharge machine is often "tooled' for making straight-on cuts where no displacement or cutting "around-corners" is involved. Square, rectangular, or triangular slots are cut for metering ports in hardened valve slides, pistons, and bodies by the Elektrojet machine, Fig. 4. The ability of this machine to cut narrow slots now permits certain valves to deliver

a true linear flow response because slits can be cut through the slide walls in place of the small holes formerly drilled through the walls. When drilled holes were used, the output curve consisted of a series of jogs instead of the true linear curve described by EDM-slotted valve sleeves. Obviously, drilling also posed many subsequent mechanical problems because it was necessarily done prior to hardening.

The trend in materials for missile valve bodies is toward precision-molded stainless in the 400 series of alloys. The greater strength of these heat-treatable alloys often overcomes the apparent weight advantage of aluminum. Their use results in a valve body which handles the unusually high operating pressures now being specified, with a strength-to-weight ratio exceeding

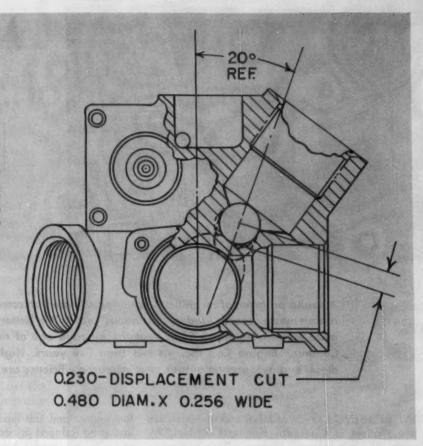
Fig. 4. Bodies, cylinders, and pistons of high-reliability aircraft valves made by Hydra-Power Corporation have rectangular porting slots. The three bodies on the left are precision-molded stainless in the 400 series. Right, center, is a hardened valve slide with square ports, and below it, a piston with square ports, all machined on the Elektrojet.



anything possible using aluminum alloys. Also EDM cuts the 400 series of stainless alloys in hardened and ground condition without affecting the high dimensional stability and hardness of the orifices essential to precision servos.

The electrical-discharge machining method offers attractive possibilities in several more fields such as the machining of odd shapes in heattreated superalloys. EDM is reducing "bench" time in the sinking of cavity type dies by making the final detailing cuts after a Hydrotel machine has roughed out the cavity. Such work requires

Fig. 5. Details of the cuts made in the aluminum body by "rubber tooling" are shown in cross section. Preliminary Woodruff cuts are machined from the bore on one side and from the cylinder on the other side. "Rubber tooling" cleans out the remaining lateral web and leaves no burrs.



available equipment heavier in capacity than the 15-ampere unit used by Hydra-Power. Blanking and stamping dies can be made using the punch as the electrode. The procedure greatly reduces "die-build" time and assures exacting punch-hole clearance.

Also, the method will do "forceless" machining, described as the cutting of odd-shaped contours at unusual angles through flimsy multiplewall titanium or stainless casings for jet engines. The electrical-discharge method will also make burr-free cuts in laminated, silicon-iron magnet cores for transformers, stators, rotors, and relays. Pyrophoric materials, such as beryllium, can be machined accurately by EDM without fire hazard.

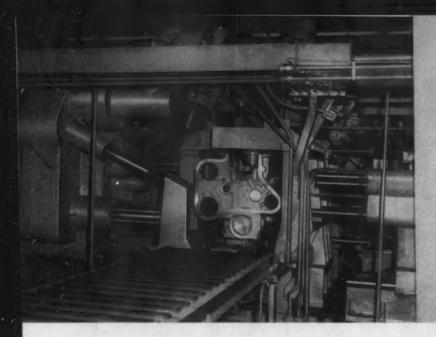
In all cases, port-to-port positioning can be held to a tolerance of 0.0001 inch.

Film Portrays Specialty-Steel Making

"Specialty Steels" is the title of a new forty-five-minute, color film recently produced by the Crucible Steel Company of America to illustrate the science and the art which go into making stainless and tool steels. Helmets, goggles, and gas masks were worn by the camera crew, who often pushed close to the electric melting furnace to photograph the molten steel. They were also protected by portable asbestos shields. Exposed and unexposed film was stored in a portable refriger-

ator during the shooting of these scenes to prevent damage from the intense heat.

Film sequences on the making of stainless steel were photographed at the company's mill at Midland, Pa., while those on tool steels were taken at the Sanderson-Halcomb Works, Syracuse, N.Y. Produced to give viewers a better understanding of these steels, the film will be of particular interest to steel users, technical societies, and engineering schools.



Modern

MMT=PE

A sound program of machinery replacement based on comprehensive maintenance records and a continuous search for better tools and more modern equipment has kept the average age of machines at Cummins Engine Co., Inc., at less than five years. Higher quality diesel engines, greater output, and increased efficiency are the results

INCREASING COSTS of labor and materials are being offset at Cummins Engine Co., Inc., by improving production efficiency. This is accomplished by using the most modern machine tools available and replacing equipment whenever it is proven inefficient. In the highly specialized field of diesel-engine manufacture, the highest quality and most productive machine tools are an absolute necessity.

The company continually searches for better machines and more modern processes that will increase the production of higher quality diesel engines and improve the efficiency of plant operations. It is considered wasteful to have obsolete machines in the plant, and they are replaced—even if they are in good condition—as soon as more productive ones become available. None of the established formulas or methods are used to determine when a machine should be replaced, and there is no inflexible system on how much should be spent for this purpose. Rather, replacement is based on need and the possibilities of improving the product and cutting the cost.

As a result of this dynamic equipment-replacement policy and intensive mechanization and cost-reduction programs during the past six years, Cummins has been able to raise wages and extend fringe benefits, improve the quality and performance of its engines, and absorb increases in the cost of raw materials. At the same time it

has maintained the basic prices of its engines and even reduced prices on some models. In this same period, profits have risen.

Decisions on new equipment for replacement or expansion are based on a long-term program with periodic reviews. Many years ago the company established a seven-year, capital-budget forecasting program that takes into account anticipated sales, necessary capital expenditures, and machine tool requirements to meet projected production requirements. A specific item in the program entitled "Plant Improvement" includes replacement items of manufacturing equipment. The program is implemented with annual budget determinations, and supplemented by more frequent reviews as circumstances warrant.

The Manufacturing Engineering Department receives yearly estimates from every shop in the plants as to what specific equipment will be needed to meet forecasted sales requirements up to seven years in advance. Also, the assistance of supervisors and foremen is actively solicited to determine which machine tools might be replaced to improve the quality of the product and reduce production costs. This system of encouraging production people to actively participate in over-all management has been a vital factor in keeping the plant up-to-date.

Comprehensive maintenance records kept on each piece of equipment are an important tool

Machine Tools Increase Production Efficiency

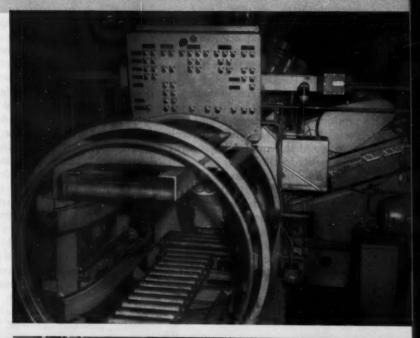
R. B. STONER, Vice-President—Operations
Cummins Engine Co., Inc.
Columbus, Ind.

in helping management make sound decisions with regard to machine selection and replacement. Each maintenance record card shows when the machine was purchased and how much it cost, its serial number and model, its location in the plant, and the yearly and total maintenance costs to date-including replacement parts and labor. Also, a weekly report is prepared showing the highest costing machines (with respect to labor only) for breakdowns and repairs. These reports also show which machines of those listed have appeared on previous reports.

Both the permanent maintenance record cards and the weekly reports are compiled from daily maintenance job cards on which standardized code numbers are used to identify the part of the machine on which maintenance was required, the cause, and the action taken. With such standardized coding, the data can be mechanized for high-speed processing.

Fig. 1. Transfer machine for progressively drilling deep oil holes, and milling and tapping diesel-engine blocks.

Fig. 2. Six-station, rotary-indexing machine having both horizontal and vertical, multiple-spindle units for machining cylinder heads.





This accurate record-keeping serves as a practical guide in determining whether a machine is doing its job efficiently and well. Those machines having the highest over-all maintenance cost in direct relation to their original cost are the most likely prospects for immediate replacement.

Lists of requested equipment submitted by the supervisors and foremen of various departments and the maintenance record cards are screened and reviewed by the Manufacturing Engineering Department. Summations of the recommendations are submitted to the Capital Budget Department, where they are tabulated on standard forms and presented to the management.

A series of meetings is held by various levels of management—from foremen to top executives—in September, October, and November of each year to justify or revise the recommendations for the replacement of existing machines or the purchase of additional equipment, and to assign priorities to the most urgently required items. Also, the long-range machinery purchase plan is revised on the basis of these discussions. For example, instead of recommending the purchase of a \$60,000 machine tool to meet the anticipated production requirements during 1960, a recommendation might be made to purchase a \$100,000 machine that would take care of projected requirements for 1963.

The final decision on any substantial purchase of machine tools, as well as approval of the entire budget, is made by the executive vice-president, who is very familiar with specific requirements since he actually worked in the shop. To provide flexibility, the budget is reviewed every three months to determine any immediate needs.

Another activity at Cummins that has been responsible for many machine tool replacements is an active cost-reduction program. A cost-reduction committee, consisting of twenty mem-

bers from various departments, meets every week to consider all ideas submitted for means of improving the products, revising manufacturing methods, and cutting manufacturing expenses.

Purchase of the Bausch transfer machine seen in the heading illustration and Fig. 1 was the result of an idea for both improving and reducing the cost of the product. On earlier models of Cummins diesel engines, tubular oil lines were mounted on the outside of the engine blocks. It was agreed that internal oil lines would improve the appearance and performance of the engines, as well as reduce their cost. However, it was found that drilling, milling, and tapping of the various deep holes in the block on individual, single-purpose machines was uneconomical. As a result, the machine shown was obtained, and the purchase price (over \$200,000) was paid out of cost savings within the first year.

Another example of the modern equipment used at Cummins to increase production efficiency is the Barnesdril machine shown in Fig. 2. This unit has a six-station, rotary-indexing, workholding table. Multiple-spindle heads are provided at five of the stations for machining the cylinder heads, and the parts are loaded and unloaded at the sixth station. The Landis multiple-wheel grinding machine seen in Fig. 3 is used to finish simultaneously five bearing surfaces on each diesel-engine camshaft. This machine represents part of the company's plant expansion, rather than replacement of an existing machine, since the camshafts were previously purchased from an outside source.

A Bullard eight-spindle Multi-Au-Matic has paid for itself in three years as a result of savings over operations previously performed on several single-purpose machines. The machine is used to turn, face, and bore the engine side of flywheels. Versatility and ease of setup is an important factor on this equipment, since it is necessary to produce more than 500 different types of flywheels to carry out the Cummins policy of custom-fitting each engine to customer needs.

By purchasing, exploiting, and rapidly writing off new machines, and then downgrading or disposing of them as soon as better machines become available, Cummins feels that it is in a stronger and better competitive position than ever before. It is the company's firm belief that a sound program of machinery replacement is a major requirement for success. As a result of their vigorous policies, the average age of the more than 1400 machine tools is less than five years.

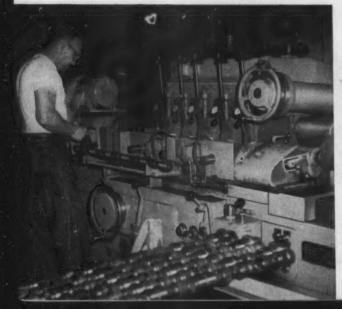
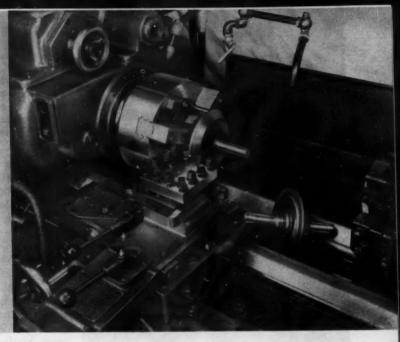


Fig. 3. Multiple-wheel grinding machine for simultaneously finishing five bearing surfaces on a diesel-engine camshaft.

Power-Operated Chucks Hold Down Production Costs

HARRY L. STEWART



WITH TODAY'S TREND toward increased automation, hydraulic and pneumatic chucks are coming into increasingly greater use. Power-operated chucking devices are readily applied to equipment that is manually loaded as well as to fully automated setups. Reduced operator fatigue and instantaneous chuck functioning, which result in lower floor-to-floor time, are important advantages of this equipment. In addition, gripping pressures can be accurately predetermined and uniformly maintained.

Typical application of a three-jaw, compensating type air-operated chuck is seen in Fig. 1. The part, which is being machined on a Sundstrand automatic lathe, is held between centers; one located in the chuck and the other in the tailstock. The jaws of the chuck are gripping on

a rough surface, but since they are free to float, no side thrust is placed on the work-piece even though it may be as much as 1/4 inch eccentric. Compensating, power-operated chucks are generally used for second operation work.

A three-jaw, power-operated chuck with serrated master jaws keyed with a serrated key to the top jaws is seen in Fig. 2. The gripping portion of the top jaws is relieved in order to provide the maximum (point) pressure possible. This is often done when machining castings so that the jaw points will penetrate the skin of the casting and grip the solid metal. Serrated jaw chucks are used on heavy-duty applications where extreme pressures are transferred back to the master jaws.

In the heading illustration, a three-jaw, uni-

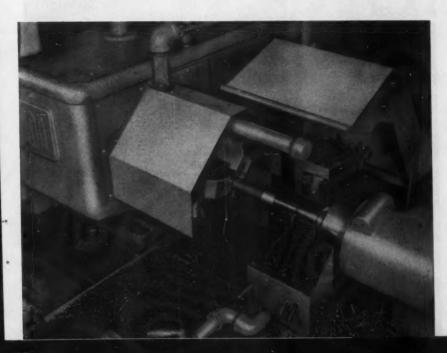


Fig. 1. This work-piece is held between centers and gripped on a rough cast surface by three floating jaws of a compensating type power-operated chuck.

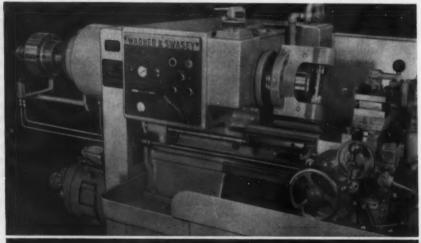


Fig. 2. Here, for heavy-duty applications, is a power-operated chuck having serrated master jaws. Top jaws are keyed to the master jaws with a serrated key.

versal type power-operated chuck is seen mounted on a Warner & Swasey turret lathe. Replaceable, soft, top jaws grip the shaft of the work-piece, and a locator pin which aids in positioning the work extends from the body of the chuck.

An air-operated, power-indexing, two-jaw chuck which can be used to hold pipe crosses, tees, and elbows, or other multiple-ended work-pieces for machining is shown in Fig. 3. With this setup, generally only one chucking of such parts is necessary. A slight adjustment of the air control valve indexes the work in the chuck so

Fig. 3. A two-jaw, air clamping and indexing chuck for machining multiple-ended parts such as pipe fittings in a single chucking. Work can be indexed without stopping the machine spindle.



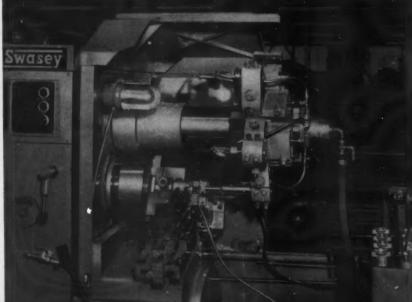


Fig. 4. Special jaws on a twojaw, power-operated chuck are employed to hold small irregular-shaped castings in this single-spindle automatic chucking machine.

Fig. 5. Here, an automotive part is nested in the jaws of a hydraulically actuated stationary chuck for the facing operation which is performed in this special machine.

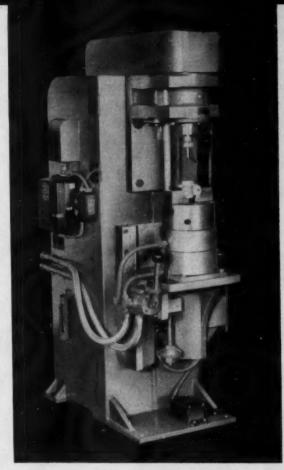
that the necessary machining can be accomplished on the several ends without stopping the lathe spindle. The rotating cylinder at the extreme left of the headstock operates the indexing mechanism while the nonrotating cylinder at the right of the rotating cylinder opens and closes the chuck. Another application of a two-jaw, air-operated chuck is shown in Fig. 4. This chuck is mounted on a Warner & Swasey single-spindle automatic chucking machine being used for turning and facing small castings.

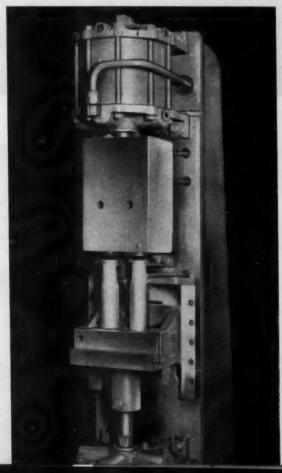
The special machine seen in Fig. 5 employs a 7-inch, two-jaw, hydraulically actuated chucking device to hold automotive parts for a facing operation. The jaws are shaped in the form of a nest for the work-piece. During facing, a hydraulic cylinder in the head of the machine raises the table and the work toward the cutter. The depth of cut is controlled by a stop on a threaded rod located alongside the table. As the work-piece approaches the facing tool, a cam on the table carriage activates a flow-control valve which causes the table to move slowly while the cut is taken.

A machine which resizes the necks of cartridge cases of shells which have been fired is illustrated in Fig. 6. For this operation the base is securely held in an air-operated, chuck-like vise. The jaws of the vise conform to the base of the cartridge cases so as to hold them securely without marking them.

The sequence of the operation is as follows: Two cartridge cases are placed into the vise and the operator depresses the starting button. The vise cylinder immediately closes and the piston of the cylinder at the top of the press advances. This causes resizing tools to enter the necks of the shells. At this point in the machine cycle, the piston of the cylinder at the bottom of the press advances, pushing the cases into female dies which smooth the necks of the cartridges. Then the lower piston retracts and the resizing tools iron out any remaining deformations. Finally, the upper piston retracts and the vise opens, thus completing the cycle.

Fig. 6. A power-operated chucking device is incorporated in the automatic cycle of this press for resizing the necks of cartridge cases.







In Shops Around the Country

BAFFLE BUILDER-Milling the inside of a stainless-steel core baffle for the Yankee reactor being constructed in Pittsburgh by the Atomic Power Department of Westinghouse. The fixture, designed and built by Salem-Brosius' R. H. Freitag division, Akron, extends through the work and has its outboard end supported on the shop floor. The milling spindle is driven directly by its own motor and traverses the length of the fixture by means of a rack and pinion.

Birdsboro magnetic piler and crane—first of its kind in the steel industry—handles the structurals and plates coming off Northwestern Steel & Wire Co.'s 20-inch rolling mill, in Sterling, Ill. Piler and crane are electrically interlocked and remotely controlled. The new equipment is speeding deliveries as well as providing a neater package and better strapping job.



BLOCK LINE—At this station on the truck engine block line at International Harvester Co., Indianapolis, the Footburt unit on the right drills a hole at an angle of 10 degrees 27 minutes, from a main bearing to a camshaft bearing. The drill bushing is contained in a cartridge which helps guide the inverted casting into location on the yee rolls.



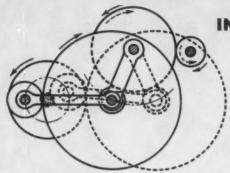
WHEEL CLEANER—Toronto Transit Commission's vehicle repair shop periodically blast-cleans the wheels of its buses as a precautionary measure to assure that the lock ring holding the tire to the wheel seats properly. The operator loads three wheels at a time in the table room of a Pangborn Rotoblast, closes door, and pushes button starting automatic cleaning cycle.

ICE CUTTER—At Rohr Aircraft, Chula Vista, Calif., Kennametal carbide cutting rings slice through stainless-steel honeycomb at rotative speeds close to two miles a minute. To prevent deformation, the honeycomb is filled with water or soap which is kept frozen on the table.

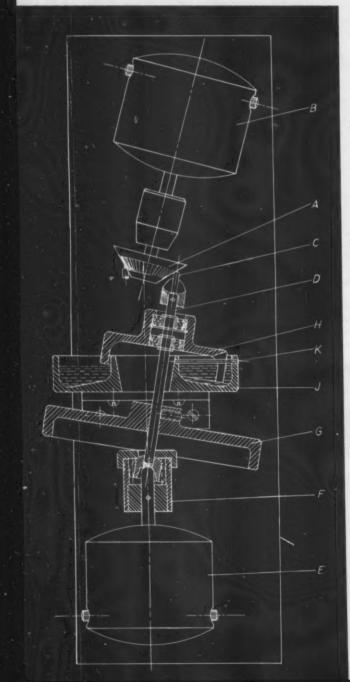








Gyroscopic Grinding Setup



J. BOAS POPPER Kirjat Mozkin, Israel

First Prize Winner in MACHINERY's recent Competition

Unique application of gyroscopic precession makes possible the grinding of diamond phonograph needles by the device illustrated in Fig. 1. In use, the setup needs little manual control and can be employed for similar operations on workpieces requiring rounded ends.

The arrangement, which resembles a toy gyroscopic top, consists essentially of a flywheel on a shaft that is rotated at high speed and allowed to precess around a given point. If, while the shaft is revolving, an object having an arbitrary profile is positioned along the precession axis and brought into contact with the precessing end of the shaft, the shaft will follow and press against the surface of the object.

To utilize this principle for grinding diamond phonograph styluses, the object is replaced by a conical grinding wheel A driven by a motor B, and the work-piece C is mounted in a chuck on the shaft D driven by a motor E through a flexible coupling F. This coupling can be a gear type or any other kind which will transmit a constant velocity. Motor B and the grinding wheel are mounted so that their axis is at an angle to that of motor E.

The flywheel G is mounted on shaft D and a braking wheel H is supported on antifriction bearings on the same shaft. The braking wheel is immersed in heavy oil in a fixed container J. A pin K prevents the braking wheel from completely revolving on its axis but allows the stylus and shaft to circle or precess around the rotating grinding wheel. Thus, work-piece C revolves about its own

Fig. 1. A device for grinding diamond phonograph styluses. Gyroscopic precession causes the rotating stylus to press against and travel around the rotating conical grinding wheel (A).

Fig. 2. Each stylus is required to be ground between the angles X (= 60 degrees) and Y (= 120 degrees) or for a spherical zone equivalent to 90 degrees. Included angle of grinding wheel cone (90 degrees) and axis inclination (15 degrees) is determined by this relationship.

axis, and, because of the gyroscopic precession effect, also moves around cone-shaped grinding wheel A. Since the stylus contacts the wheel at different heights and angles successively, a rounded head is obtained. The speed of grinding is increased by running the two motors in the same direction, thereby adding their relative

tangential speeds.

The pressure of the work-piece against the wheel is a function of the speed of precession—the velocity with which the shaft moves around the wheel. Another factor is the height of the center of gravity of the shaft. This latter can be adjusted by raising or lowering the flywheel. The centrifugal force of the flywheel is constantly opposing its gyroscopic tendency to press against the wheel. Therefore, by raising the flywheel, the lever arm of the centrifugal force is lengthened,

increasing its effect.

Relative motion between the work-piece and grinding wheel causes a moment tending to accelerate precession, resulting in higher pressure and diminution of the relative grinding speed. To prevent this, the braking wheel H is mounted on the shaft and immersed in the heavy oil contained in member J, which is attached to the frame of the device. Since it is mounted on ball bearings. the braking wheel does not disturb the constant rotation of the shaft around its axis, but the oil's viscosity does prevent too fast a precession of the shaft around the grinding wheel. This also permits the possibility of obtaining elongated and flattened forms by inclining one side of the braking wheel more into the oil, consequently slowing the work-piece as it passes over any desired section of the wheel. The pressure of the work-piece against the wheel is also raised by increasing the speed of motor E and the moment of inertia of the flywheel.

The stylus is contacted by all of the area shaded on the grinding wheel as seen in Fig. 1. This is important for even wear of the wheel. Motor B can also be moved in the direction of its axis, thus changing the portion of the grinding wheel being used without affecting the adjustment of the

whole assembly.

In the case under discussion, the stylus has to be ground only in the area between the angles X (= 60 degrees) and Y (= 120 degrees) as illustrated in Fig. 2, because the actual working angle of the diamond point in the record groove is equal to only 90 degrees. This means that one



flank of the grinding wheel has to be inclined at an angle of 30 degrees from the vertical, and the other side inclined by $\frac{X}{2}$ or 30 degrees from the horizontal. Consequently, the required cone angle of the grinding wheel is 90 degrees and the inclination of motor B from the vertical is 15 degrees. The actual setup was built for grinding a diamond-stylus radius of 0.0008 inch.

Titanium Welding Report

Methods for welding titanium piping and tubing by the gas tungsten-arc process are explained in a twenty-four-page report published by the American Welding Society. A complete description, from an explanation of the welding process to the selection of electrode and filler metal, is given. The information was obtained from current welding literature, company files, research laboratories, and colleges; it was carefully examined by an AWS committee and approved by acknowledged experts in the field. Data on process, power supply, electrodes and filler metal, titanium grades, joint design and preparation. cleaning, gas shielding, welding techniques, heattreatment, and weld-quality tests are contained in the report. The booklet, which gives actual procedures that can be followed with confidence. will solve many problems for those who are involved in titanium fabrication. It is available from the American Welding Society, Department T, 33 W. 39th St., New York 18, N. Y., at a cost of \$1.50 per copy.

TOOL ENGINEERING

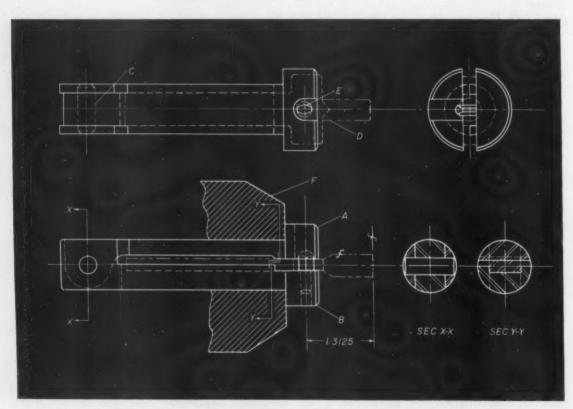


Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Novel Work-Holder for Lathe Operations

CLIFF BOSSMANN, Dayton, Ohio

Frequently, a flat work-piece must be turned on one end and faced to obtain an accurate dimension. A good device for holding such parts in a collet or chuck for these operations is illustrated. pin E. In this case, locating the work-piece by the 5/16-inch-diameter hole permits the 1.3125-inch dimension to be accurately held. Member A serves only as a clamp. Clamps A and B are as-



Hinged work-holding fixture that fits in chuck or collet to facilitate performance of lathe operations on flat parts. Component is positioned by a diamond locator pin.

The holder consists of two clamping members A and B which are hinged on dowel-pin C. The part D is set in a nest in member B, as shown in Section Y-Y and is positioned by diamond locator

sembled with the hinge pin and the assembly is ground on the periphery. This makes it possible to hold the assembly in a collet F (or chuck) for a turning or facing operation.

Handy Bench Micrometer for Three-Wire Measurements

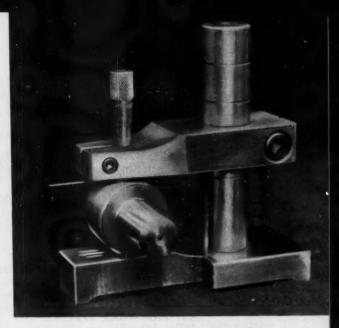
H. J. GERBER, Stillwater, Okla.

Three-wire measurement of screw threads is an accurate but usually cumbersome operation. If frequent inspection of thread plug gages or precision threaded work is necessary, the making of a simple bench micrometer of the type here illus-

trated may prove a timesaver.

This measuring tool consists of three major parts, all made from bar stock. The base is carburized, hardened, and ground on all bearing surfaces, and the anvil surface is lapped to a low micro-inch finish and a high degree of flatness. A cylindrical column, which is also carburized, hardened, and ground, is pressed into a bored hole in the base. An adjustable arm equipped with a small vernier micrometer head that reads in tenths of thousandths is then fitted to the column.

To use the instrument, a stack of gage-blocks equal to the desired measurement over the work and wires is placed on the anvil. The arm is lowered and locked on the column so that the mi-

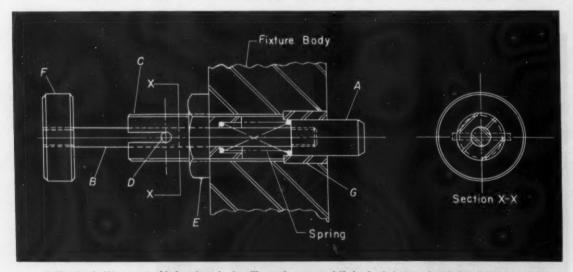


Bench micrometer that is convenient for measuring screw threads by the three-wire method.

crometer reads zero when its spindle is in contact with the stack of blocks. After the work is set up on two wires on the anvil, a micrometer reading over the third wire placed on top of the thread will show any deviation from the standard measurement as set with the gage-blocks.

Fast-Acting Retractable Locator

ROGER ISETTS, Kenosha, Wis.



Pulling knob (F) retracts this locating pin, it will remain retracted if the knob is turned to bring dewel-pin (D) over the end of housing (C). A spring is used for the return movement.

It often becomes necessary, on fixtures and dies, to provide one or more pins that can locate or hold a part while an operation is being performed, then may be pulled back to permit loading and unloading. Although there are numerous ways of doing this, many are slow-acting and not entirely positive.

Illustrated is a simple arrangement that over-

comes most of these objections, yet is relatively inexpensive to construct. Locating pin A should be made of drill rod or tool steel, hardened and ground. Its front end is chamfered to facilitate entry into the work-piece, and the opposite end is tapped to receive stud B.

A round, externally threaded housing C is drilled through the center to accept stud B. The front end of the housing is counterbored to serve as a spring pocket, while the other end is slotted to receive a small dowel-pin D that is pressed into the stud. The entire unit can be assembled before inserting it into the fixture body. A lock-nut E secures the unit in place.

To load the fixture, the operator pulls back on

knob F until dowel-pin D is out of the slot. A slight turn causes the pin to ride on the end of housing C, retaining locating pin A in a retracted position. This leaves both hands of the operator free for other duties.

If extreme accuracy is needed, a bushing G should be pressed into the fixture body to prevent wear. For less precise work, or for low-production jobs, this bushing can be omitted. The distance that the locating pin protrudes from the fixture body can be adjusted. To do this, lock-nut E is first loosened, and then knob F is rotated in the appropriate direction. Engagement of dowel-pin D in the slot will permit the housing and the shaft to be turned as one unit.

Self-Locking Driver for Parts with Socket Head

ALFRED H. K. HAEUSSLER, Chicago Ridge, Ill.

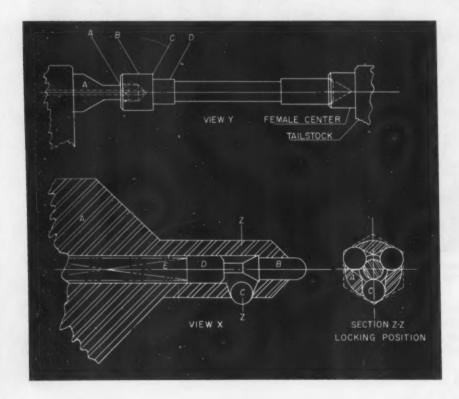
An ingenious self-locking device which utilizes three balls for driving long cylindrical parts having a hexagonal socket in one end is here shown. The device is intended for use in a lathe equipped with an air-actuated tailstock.

View Y illustrates the self-locking driver being applied for holding a part that is machined on surfaces A, B, C, and D. In loading the work, the socket end of the work is advanced over the reduced section of adapter A until the bottom of the socket hole has contacted plunger B, View X.

The plunger is pushed back into adapter A until its tapered section has forced balls C radially outward to lock them against the sides of the hexagonal socket.

When the tailstock spindle is retracted, coil spring E returns plug D and plunger B forward, releasing balls C so that the socket end of the work can be removed from adapter A.

With this method of driving, parts with hexagonal sockets are positively held, concentric with the centers of the headstock and tailstock.



Self-locking device designed for driving parts having a hexagonal socket in one end.

MMT = PE



Special tools and automatic chuckers reduce machining time on large sleeve bearings up to 45 per cent

Precision Bearing Machining ... AUTOMATICALLY

AT Cleveland Graphite Bronze Division, Clevite Corporation, semifinish machining of a variety of large sleeve bearings has been until recently a turret-lathe job demanding highly skilled operations. The particular work-pieces involved are rod and main bearings, both plain and flanged, for diesel engines. Lot sizes range from a few pieces to many thousands.

Each bearing comprises two sections, produced by either "shell" or "strip" methods. In Fig. 1 is shown one section of a bearing made by each method. In the shell method, the bearing begins as a cylinder (a steel forging or piece of tubing) which is cut lengthwise into two sections after machining. The strip method utilizes pieces of flat steel plate. Soft liner metal is cast on the plates, which then are formed into semicircles prior to machining.

On the turret lathe, at least two chucking operations were required. High setup and handling costs, plus the comparatively low output in terms of manpower and equipment, clearly

Fig. 1. Segments of the two bearing types machined on the chucking automatics. The shell type (left) is segmented after machining; the strip type (right) is formed into semi-circles prior to machining.

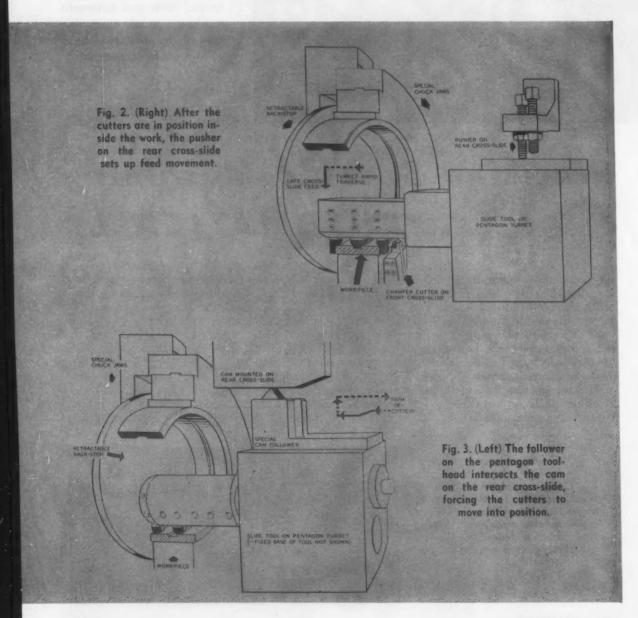


dictated a switch from manual to automatic operation. This, however, was no simple undertaking, because of the variety of bearing sizes and types being produced. In addition, almost every surface had to be "single-pointed," with no tool withdrawal marks permitted. Methods men particularly wanted to eliminate the second chucking operation on the strip bearings. Thus, any equipment selected had to be capable of facing and chamfering the back of the bearings along with the other machining operations—again without tool withdrawal marks.

Through an interesting combination of special tooling and a pair of Warner & Swasey 3AC single-spindle chucking machines, the company

now has succeeded in putting bearing production on a successful automatic basis. What is more, by applying a modification of the MAPI formula, the after-tax return on the investment of \$96,810 in the equipment is estimated to be 22 per cent. This does not include the additional savings from the increased capacity and the reduction in severity of a manufacturing bottleneck without adding manpower or increasing working hours.

Complete machining is handled with only three tooling stations on the machines' pentagon turret, plus a front cross-slide chamfering operation. The "early" and "late" stroke functions of the rear cross-slide are utilized with the operation of the turret stations. Mounted on the rear



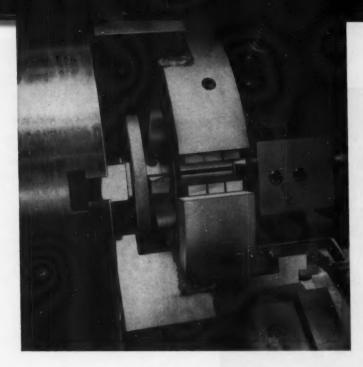


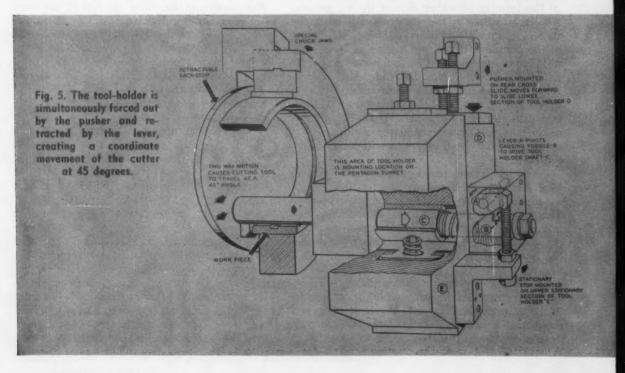
Fig. 4. The back-chamfering cutter can be seen near its starting point between the work and the back-stop, which is retracted.

cross-slide are a cam and a pusher. The pusher is used in conjunction with the first and third tooling stations; the cam, with the second.

Handling the two separate pieces as a set, in the strip method, raises some problems in holding the work. As can be seen in the heading illustration, wrap-around jaws are used to hold the segments firmly but without distortion under chucking pressure. A special, retractable, airoperated back-stop permits machining of both ends of the work in a single chucking. The back-stop moves forward when the chuck opens; then,

after the chuck is closed, the back-stop retracts to allow working room for the back-facing and back-chamfering cutters.

In the heading illustration, the first of the three pentagon turret stations used is shown in operative position. It is set up to cut an internal oil groove, face both ends of the work, and chamfer both inside corners. A diagram of the tooling appears in Fig. 2. The pentagon cutters are traversed forward into the work, followed by a "late" rear cross-slide stroke in which the pusher on the cross-slide moves the cutters at right



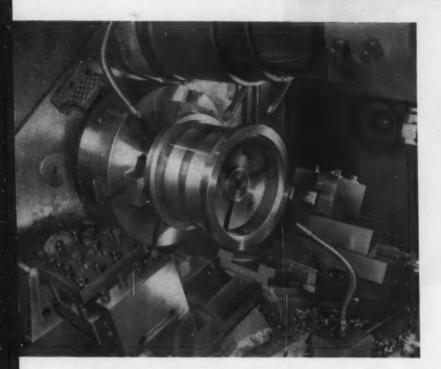


Fig. 6. The expanding arbor supporting shell type bearings is actuated by the same air mechanism which operates the back-stop used with strip type bearings.

angles to the spindle center line and feeds them to proper depth. Simultaneously, the front cross-slide moves in to chamfer the outside front corner.

At the second station, Fig. 3, two cutters arranged in tandem finish-bore the inside lands of the bearing on either side of the oil groove. An "early" stroke by the rear cross-slide advances its cam into position. During the forward traverse of the pentagon turret, the cam is picked up by a follower on the boring tool-head, which is mounted on a spring-loaded slide. The head is forced out and the cutters are brought into position. Feeding motion of the pentagon turret then makes the tandem boring cut. Upon completion of the cut, the follower snaps free of the cam, retracting the tool-head before its withdrawal from the bore.

Back-chamfering, performed at the third station, completes the rear of the bearing, eliminating the separate chucking previously required. This operation, Fig. 4, uses a 45-degree cutter in combination with the "late" cross-slide function to reach the outside rear corner from inside the bore. A diagram of the tooling appears in Fig. 5.

Initially, a special tool-holder, also slidably mounted, traverses forward with the pentagon turret through the bore until the tool is beyond the work. Then the rear cross-slide moves in and its pusher causes the tool-holder to cross-feed. When the cutter reaches its starting point, a lever

on the sliding portion of the tool-holder contacts a stop-screw on its fixed base. As the tool-holder continues to feed out, it also is made to retract in a one-to-one ratio by the pivoting of the lever, and the cutter feeds at 45 degrees for the required chamfer.

For maximum handling efficiency, the company generally runs the same job simultaneously on both automatic chucking machines, even small lots. Only one operator is required. The saving over previous turret-lathe time for the strip bearings is impressive—40 to 45 per cent—due in part to elimination of the second chucking.

On shell bearings, less time is saved, but substantial economies result from the reduction in direct labor (one operator in place of two) and in the small amount of work spoilage because of the machines' repetitive accuracy. In addition, the easy setup of the equipment lends itself to planning and scheduling jobs which are similar in nature.

Outside-diameter turning of flanged bearings is performed by supporting the work internally on an expanding arbor. The same air-operated mechanism which automatically retracts the back-stop for strip bearings is used to expand the arbor in this setup, as can be seen in Fig. 6.

On some flanged bearings the outside diameter between the flanges is turned by a slide tool held on the cross-slide. The cutting tool is positioned behind the front flange, and the slide tool is then advanced by a pusher on the pentagon turret.

MACHINERY'S

Reference Section

MEASUREMENT ERRORS IN GEAR ROLL TESTING -their properties and how to deal with them



RICHARD L. THOEN

Mechanical Division

General Mills, Inc.

Minneapolis, Minn.

May. 1960

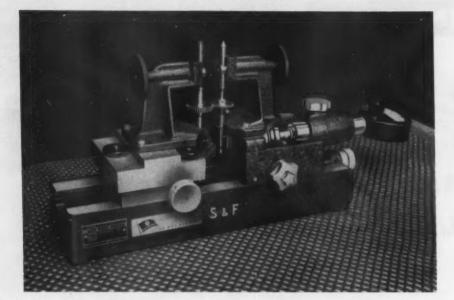


Fig. 1. A gear roll tester equipped with mounting centers and means for adjusting gear-axis alignment. Work gear (right) is wrung onto a center-mounted arbor.

Measurement Errors in Gear Roll Testing

Unless precautions are taken, significant errors in measurement can occur when roll-testing gears. A knowledge of what these errors are and of their characteristics will help in minimizing them. The author discusses methods of obtaining the most accurate results from roll-testing equipment

The Two-Flank Gear Roll Test is widely used for measuring effective tooth thickness, total composite error, and tooth-to-tooth composite error. Yet, paradoxically, the characteristic errors present in measurements obtained by roll-testing gears (heading illustration) are not generally understood. Perhaps this arises from a natural reluctance to inquire and make changes, or from the seeming simplicity of the test itself. Whatever the cause, significant errors do exist in many if not most present-day roll-test measurements. It is the purpose of this article to describe the nature of these errors.

How Gear-Mounting Methods Affect Errors

Gears can be mounted in many different ways for roll testing . . . on fixed studs, on rotating arbors, in fixed bushings, in vees, between centers, etc. As so often is the case in inspection practice, different methods can produce different results. It is important, therefore, that the designer, who has the responsibility for designating unambig-

uous datum surfaces, recognize the limitations inherent in each of the alternate methods employed for mounting.

For example, the out-of-roundness of the bore of a gear mounted on a fixed stud will affect both effective tooth-thickness and total composite-error measurements. A loose fit will permit the gear to tilt and accommodate lead error, tooth taper, and erratic driving forces, thereby causing errors in all three measurements. A tight fit will spread the center distance because of the angular drag, while variation in bore diameters from one work gear to the next will cause false effective tooththickness indications. Lastly, the operating clearance between the stud and the bore is dependent upon such intangibles as the effective contact area, the amount of oil, the presence of foreign matter, and the driving speed. These same conditions also apply to a gear with an integral shaft mounted in fixed bushings.

When mounting a gear with an integral shaft in vees that have their center line parallel to the carriage movement, any bearing surface imper-

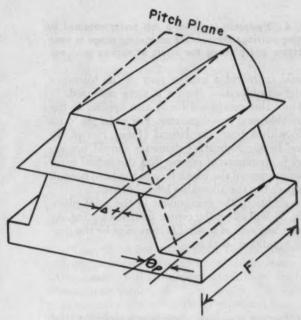
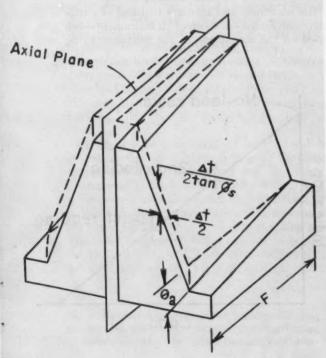


Fig. 2. The component of gear-tooth misalignment Δt in the pitch plane should be small compared to the tolerances for effective tooth thickness, pitch error, and lead error.

Fig. 3. Center-distance setting of gears is affected by the axial component of gear-tooth misalignment. The maximum allowable value for this component is in fact limited by the smallest of a number of factors.



fections (out-of-roundness, surface flaws, and skewness) will affect the effective tooth-thickness and total composite-error measurements. Functionally, bearing surface imperfections can often be quite large.

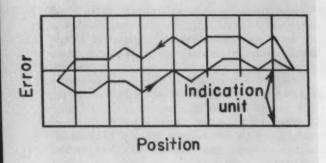
Variation in bearing diameters from one work gear to the next will cause false effective tooth-thickness indications, the degree of error being determined by the vee angle. Wear on the vee surfaces, which occurs very quickly because of the line contact, can bias the effective tooth-thickness indication.

On the other hand, when the vee center line is perpendicular to the carriage movement, dissimilarity between the two bearing surfaces (out-of-roundness, surface flaws, skewness, and size) will cause axis misalignment and thus influence the effective tooth-thickness and total composite-error measurements. In addition, the clamps which perpendicular vees require can affect the effective tooth-thickness indication, a loose clamp permitting the gear to climb the vee and a tight clamp causing angular drag, thereby spreading the center distance.

As a rule, the errors arising from all these conditions can be held to an insignificant level. In most cases, this can be readily achieved by mounting both the master gear and work gear between centers. Bore type work gears are wrung onto arbors which, in turn, are mounted on centers, as illustrated in Fig. 1.

Of course, the accuracy of the mounting centers and arbors must be considered. See Machinery, March 1957, pages 174-177. (Small mounting centers and arbors made of carbide and accurate to within 15 micro-inches for size and runout are relatively inexpensive.) Consideration should also be given to the method of constraining the mounting centers. Perhaps the best method is the classical cylinder-in-vee arrangement where both of the vees are incorporated in a common member of the instrument (Fig. 1).

It is often said that checking shaft type gears on centers is not functional, since in general they do not operate on centers. However, these gears are ordinarily cut on centers. Their bearing diameters are ground while mounted on the same centers, and the resulting bearing runouts—as compared to the effective tooth-thickness (converted to center distance) and total composite-error tolerances—are for the most part insignificant. Moreover, in the great majority of cases the only practical way of specifying straightness, roundness, and relative alignment of the bearing surfaces is with respect to centers. In establishing an unambiguous datum, centers are generally superior to bearing surfaces.



Provision for Axis Alignment Desirable

Clearly, a relative misalignment of roll-tester axes will cause an error in measurement. In practice, alignment requirements can impose rather exacting demands on workmanship, so much so that a provision for adjustment may be highly desirable, Fig. 1. Perhaps the easiest way to establish alignment requirements and to measure misalignment is to work with the components of misalignment in the pitch and axial planes, Figs. 2 and 3.

The component in the pitch plane (Fig. 2) will affect all three measurements and cause end bearing (also known as cross bearing, end contact, and edge contact). Any one of several factors may be the limiting condition. Thus,

$$\theta_p = \frac{\Delta t}{F} \tag{1}$$

where

 θ_p = allowable misalignment in the pitch plane, inches/inch; Δt = apparent change in tooth thickness, inches;

F = active face width, inches.

The value of Δt should be small compared to the tolerances for effective tooth thickness, pitch error, and lead error. Also, θ_p should be small compared to the assembly misalignment. In practice, however, none of these tolerances may be explicitly stated, in which case the effective tooth-thickness tolerance is derived from the testing radius, a dimension over pins, etc. The pitch error is computed as twice the tooth-to-tooth composite error times tan ϕ_n (where ϕ_n is the standard pressure angle), and the lead error and assembly misalignment are estimated.

The apparent change in tooth thickness is a biased error (always plus). Therefore, this error

Fig. 5. Graph showing how the indicated size changes with the gear-checking load. The no-load value is obtained by extrapolation.

Fig. 4. "Hysteresis loop" of a roll tester obtained by moving carriage through the measuring range in each direction and plotting the errors at various positions.

should represent a smaller part of the tolerance under consideration than if it were unbiased.

The value computed for θ_p also applies to the allowable gear misalignment. For example, on a gear with a bore, the lateral (face) runout divided by the indicating diameter should not exceed θ_p , assuming of course that the actual error in squareness of the blank face to the bore is small compared to the allowable lateral runout.

In addition, the component in the axial plane (Fig. 3) will affect the center-distance setting. As before, any one of several factors may be the limiting condition; that is,

$$\theta_{\alpha} = \frac{\Delta C}{L} \tag{2}$$

or
$$\theta_a = \frac{\theta_p}{2 \tan \phi_a}$$
 (whichever is smaller); (3)

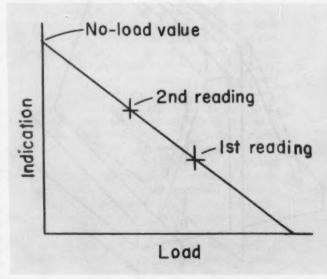
where

 θ_a = allowable misalignment in the axial plane, inches/inch; ΔC = allowable center-distance error, inches;

L = effective length of setup parts (arbors, pitch discs, etc.), inches.

Sensitivity and Accuracy-Indication Requirements

The sensitivity and accurary required of a rolltester movement—as those of all instruments—are based on the magnitude of the tolerance to be



measured. The main point of interest is the *relationship* between sensitivity, accuracy, and the tolerance to be measured. Sensitivity, of course, must not be confused with accuracy. While necessary, sensitivity is by no means sufficient. This may seem elementary, but is a point often overlooked.

Sensitivity and accuracy levels are, in the last analysis, matters of individual taste and temperament. In particular, a common interpretation of "good gaging practice" is that the instrument have (a) a sensitivity level wherein the indication unit (graduation interval) equals about one-tenth of the smallest tolerance to be measured and subtends an angle of at least 10 minutes at the eye and (b) an accuracy level that falls within the range of the indication unit. This implies that on rare occasions the greatest discrepancy in measurement will not exceed one-fifth of the tolerance to be measured.

The accuracy of a roll-tester movement can be determined by moving the carriage through the indicating range-first in one direction and then the other-and noting the error at various positions. A plot of these results is known as the "hysterisis loop," Fig. 4. (Roll-tester movements with error spreads as low as 10 micro-inches are commonplace.) The carriage can be positioned by an eccentric arbor mounted in the roll-tester centers, a wedge or tapered arbor guided between the fixed studs, an interferometer, or other suitable means. Because of the "stiction" effect intrinsic to low speeds, the speed used in approaching the various positions should not exceed the lowest carriage speed encountered in practice when setting the center distance, checking the axial alignment, or searching for extreme indications on the gear under test. Since hysteresis varies with load (zero load corresponds to infinite hysteresis), the roll-tester load should be set to the actual gearchecking load when the hysteresis readings are taken.

Generally, the gear-checking load should be no greater than that needed to meet the accuracy requirement. Exceptions occur when a greater load is needed to maintain a tight mesh at the desired checking speed, or to overcome the cushioning effects from whatever oil may be on the teeth. On the other hand, the checking load should not be great enough to significantly affect the tooth-to-tooth composite-error indication or the axial alignment. These latter effects can be

Fig. 6. Relationship between the readings obtained in the zeroing and sizing setups. Proper application of offsets (Z) and (S) will give a true size indication.

readily detected by changing the checking load and looking for a significant change in the character of the tooth-to-tooth composite-error indication and the observed value of axial misalignment.

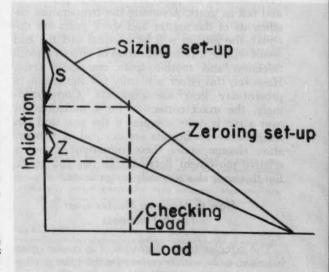
Load and Temperature Corrections

It is evident that comparative measurements are sensitive to load variations. Decreasing the load without rezeroing the comparator, for example, will cause an increase in the indicated size. This condition, which is caused by the elastic deflections of the frame, arbors, mounting devices, etc., is illustrated by the graph in Fig. 5.

The effect of hysteresis prevents obtaining a reading at or close to zero load. But since the deflection versus load characteristic is quite linear it is possible to determine the no-load value simply by plotting a few readings and projecting the curve back to zero load. The no-load value, however, is not the true size, the reason being that the condition shown graphically in Fig. 5 also exists when the comparator is zeroed to the setting gage, Fig. 6.

Thus, for any particular checking load, zeroing the comparator to the setting gage will result in an error equal to an amount Z. This error can be compensated for by offsetting the comparator to a minus Z. It follows, then, that the true size will be larger than indicated by an amount S, which can be compensated for by offsetting the comparator to a plus S. In short, an offset of S minus Z will result in a true size indication.

Most load corrections are insignificant. Often the deflection curves are practically parallel, making the load correction so small that it can be



neglected. Furthermore, as in the case of temperature correction, it is usually quite obvious in practice whether or not a load correction is in order.

If all the temperature coefficients, including those for the gage-blocks, arbors, pitch discs, master gear, and work gear, are sensibly equal, and if all the dimensional reference temperatures are the same (usually 68 degrees F.), there is no need for a temperature correction. Conversely, a temperature correction should be considered if these conditions do not exist.

Essentially, the procedure in making a temperature correction is to compute the effect of the ambient temperature on the setup parts (gage-blocks, arbors, pitch discs, etc.) and set the comparator to read true length. Usually a plus offset is involved. Then the effect of the ambient temperature on the gears and mountings is computed and the comparator is again corrected, usually by a minus offset. These offsets cancel the effect of ambient temperature on the measurement.

A simplified example may help to clarify the latter offset. Assume that the comparator has been set to read true length. Then two known lengths, M and G, would cause the comparator to read $[M + MK_M (A - R_M)] + [G + GK_G (A - R_G)]$; where K_M and K_G are the respective temperature coefficients, A is the ambient temperature, and R_M and R_G are the corresponding dimensional reference temperatures. Therefore, to make the comparator read the desired M + G measurement, an offset equal and opposite to $MK_M (A - R_M) + GK_G (A - R_G)$ should be applied.

In some cases the foregoing correction is not exact because the gears are treated as pitch discs and not as gears. Assuming the temperature coefficients of the master and work gears are unequal, the pitches will be unequal and the end result will be a false indication of effective tooth thickness and tooth-to-tooth composite error. However, this effect is usually not significant in present-day gear measurements. Correspondingly, the exact correction for a measurement over a pin is quite complex if the gear and pin temperature coefficients are unequal. A temperature change under these conditions causes a relative movement between the pin and teeth. But this error also is usually insignificant.

How to Measure Master-Gear Tooth Thickness

The circular tooth thickness of a master gear is known only within certain limits. Like gaging errors, the range of this uncertainty should be

small compared to the tolerance to be measured; in particular, to the effective tooth-thickness and total composite-error (converted to tooth thickness) tolerances on the work gear.

The limits of circular tooth thickness can be determined by mounting the master gear on the fixed side of a roll tester, mounting a ball type measuring contact (such as a ball fixed to the end of a mounting stud) on the carriage, and then taking a set of readings over a single pin. The number of readings will depend on the magnitude of the observed variation. A master with a small variation obviously will not require as many readings as one that has a variation close to the allowed limits. In addition, the gaging procedures recommended for load and temperature corrections and accurate indications should be observed when measuring the circular tooth thickness. The ratio between the indication unit and the tolerance on circular tooth thickness for the master gear need not, however, be one-tenth. Instead, a ratio of one-half, or about one-twentieth of the work-gear tolerance, is commonly regarded as satisfactory.

Roundness and straightness of the measuring pin can be checked in the roll tester. This is done by rotating the pin in a tooth space of the master gear to be checked. Of course, the same gaging procedures recommended for checking the circular tooth-thickness limits of master gears apply to the measurement of the pin diameter.

The effect of pin errors and the effect of the tooth form and position errors on the circular tooth-thickness calculation are errors in datum. The manner in which these datum errors influence the circular tooth-thickness determination is outside the scope of this article. In present-day practice, circular tooth-thickness uncertainties in the order of 30 micro-inches are not an uncommon occurrence.

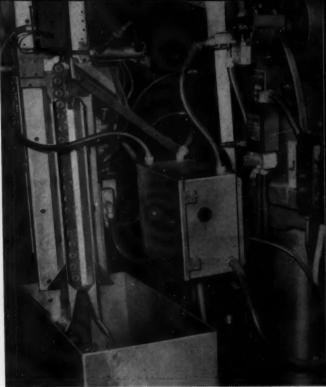
Before specifying master-gear accuracies that are difficult and costly to achieve, still another effect should be considered. A perfect master gear does not necessarily indicate how imperfect work gears will mesh with each other. In practice, this becomes significant as the effective tooth-thickness tolerance approaches the magnitude of the tooth form and position errors on the work gear. Since the assembly backlash might not be that indicated by a master, it may be more realistic to specify work-gear size in a manner similar to that in which bevel-gear size is often designated. For example, specify one work gear in terms of a center distance when meshed with a particular master or control gear, and the second work gear as having to mesh with the first within certain limits of center distance.

Magnet-Backed Belt Feed Orients Parts for Riveting

Unique application of magnetic principles is the feature of an arrangement that automatically feeds and orients bail-holding ears which are to be riveted to paint cans. Developed by Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich., the equipment shown in Figs. 1 and 2 is said to have increased production and provided greater safety for the riveting machine operator. Previously, the machine had an automatic feed for only the rivets.

The parts are placed in a hopper type bin





netized Alnico rods which transfer their field to the bars. By varying the spacing between the Alnico rods, the magnetic field can be strengthened or weakened.

In this way, a relatively weak field of attraction is provided near the center of the belt. The parts are attracted to a strong field at the bottom of the belt and are carried upward. As the ears enter the middle, weaker field, those that are improperly oriented drop back into the hopper. Correctly positioned ears are carried to the top of the belt where they are ejected into a riveter feed chute.

At the bottom of this chute, the ears are mechanically placed on the paint can by fingers operated by a foot-switch. When the ear is in position, the fingers retract and both sides of the ear are automatically riveted. The operator holds the can as seen in Fig. 2. He then turns it a full 180 degrees to nest the first ear into a locating recess in the support saddle and the riveting is repeated. The machine is designed to rivet up to 700 cans per hour.

Fig. 1. (Above) Bail-holding ears to be riveted to paint cans are seen here being carried upward on a canvas belt which passes in front of two parallel steel bars magnetized by strategically placed permanent type magnets. Ears that are not positioned properly fall back into the hopper.

Fig. 2. (Left) This riveting machine is equipped with a unique magnetic feeding arrangement that automatically orients bailholding ears to be fastened to paint cans. Operator simply positions can and trips a foot-switch to eject an our from the load chute into place for riveting.

Capacities of Hand Screw Presses

FEDERICO STRASSER, Santiago, Chile

Occasionally the use of the old-fashioned hand screw press is advantageous in certain jobs. The table below covers the most common models

OD of Screw, Inches*	Tons	OD of Screw, Inches*	Tons	OD of Screw, Inches*	Tons
1/2	0.435	1 1/2	5.30	3	23.00
5/8	0.77	1 5/8	5.85	3 1/4	26.00
3/4	1.18	1 3/4	7.1	3 1/2	31.20
7/8	1.67	1 7/8	8.0	3 3/4	34.00
1	2.2	2	9.4	4	40.00
1 1/8	2.75	2 1/4	12.00	4 1/4	41.00
1 1/4	3.60	2 1/2	15.00	4 1/2	48.00
1 3/8	4.20	2 3/4	18.50		

^{*} Single-start thread.

using the outside diameter of the screw as the governing variable. In all cases the tonnage is approximate and depends on lubrication and condition of the equipment. Force assumes a standard lever length.

The accompanying table covers most of the manual screw presses now in active use. However, in case the capacity of a press must be determined and the screw is of different size, use the following formula:

$$Q = P2\pi Ln : h$$
 lbs,

where

Q = load in pounds;

P = applied force (manual strength is approximately 50 pounds);

L =lever arm length, in inches;

n = mechanical efficiency (a well-lubricated Acme thread is about 75 per cent;

h =lead of screw (in the case of a two-start thread, the load is $2 \times$ the pitch; a three-start thread is $3 \times$ the pitch; etc.).

Tungsten-carbide washers, used as thrust bearings for a rotating head that spins a boss on the end of this automotive tie-rod to make a leakproof grease enclosure, have reduced bearing maintenance costs. Of the three Kennametal Grade K90 washers employed, the top one is assembled with a press fit against a shoulder in the sleeve that surrounds the drive-shaft. The other two are mounted loose, the bottom one being in contact with three spinner rings. At the end of a thirty-week test period, more than 600,000 tle-rods were assembled, and the only maintenance required was five regrinds on the bearing surface in contact with the spinner rings. The position of the washers in the spinning head is shown by dotted lines.





MACHINERY'S ROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

Determining a Jig-Plate Coordinate

W. W. JOHNSON, Cleveland, Ohio

In the design of the jig plate shown in Fig. 1, it was required to determine the dimension x from the dimensions given. This was done with the aid of Fig. 2 as follows.

Solution:

1.
$$\tan \phi = \frac{3.5}{x}$$
; $\tan \alpha = \frac{2.38}{x}$

3.
$$\tan (\phi - \alpha) = \tan 9^{\circ}$$

4.
$$\tan (\phi - \alpha) = \frac{\tan \phi - \tan \alpha}{1 + (\tan \phi \times \tan \alpha)}$$

This is a quadratic equation which may be solved by the standard formula:

$$x = \frac{-b = \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{1.12 \pm \sqrt{1.12^2 - 4 \tan 9^{\circ} (8.33 \tan 9^{\circ})}}{2 \tan 9^{\circ}}$$

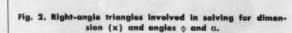
$$x = \frac{1.766952}{0.316769} = 5.578$$
 using the plus (+) sign and

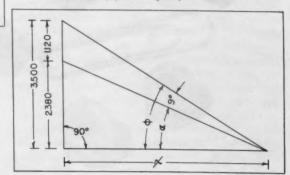
$$x = \frac{0.473048}{0.316769} = 1.493$$
 using the minus (-) sign

From the rough layout of the jig plate it was decided that the larger value of x, 5.578, was to be used. Substituting this value in the equations in Step 1,

$$\tan \phi = \frac{3.5}{5.578}$$
; $\phi = 32^{\circ}6'24''$

$$\tan \alpha = \frac{2.38}{5.578}$$
; $\alpha = 23^{\circ}6'24''$





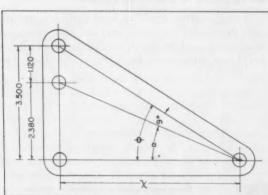


Fig. 1. Jig plate with unknown dimension (x) and angles φ and α required to fix position of right-hand hole.

5.
$$\tan 9^{\circ} = \frac{\frac{3.5}{x} - \frac{2.38}{x}}{1 + \left(\frac{3.5}{x} \times \frac{2.38}{x}\right)}$$

$$\tan 9^{\circ} = \frac{1.12x}{x^2 + 8.33}$$

6.
$$x^2 \tan 9^\circ - 1.12x + 8.33 \tan 9^\circ = 0$$

MATERIALS

The properties and new applications of materials used in the mechanical industries

High-Strength Low-Alloy Steel with Moderate Corrosion Resistance

A high-strength, low-alloy structural steel has been announced by the Armco Steel Corporation, Middletown, Ohio. It is known as "Armco High Strength No. 5." The corrosion resistance of the steel is said to be equivalent to copper-bearing mild steel. Fabrication in the as-rolled condition is limited to simple bending across the rolling direction and very light flanging and forming operations. It can be fusion-welded by any of the common methods without pre- or post-heating. Uses include railroad-car frames, truck bodies, and related vehicles requiring high strength but only moderate corrosion resistance.

Pigmented Open-End Acorn Lock-Nuts for Light-Duty Applications

Open-end acorn lock-nuts made from Du Pont "Delrin" have been developed by Russell, Burdsall & Ward Bolt and Nut Co., 100 Midland Ave., Port Chester, N. Y., for light-duty applications where corrosion resistance and reusable locking action are desirable. These lock-nuts have good strength, rigidity, dimensional stability, and re-

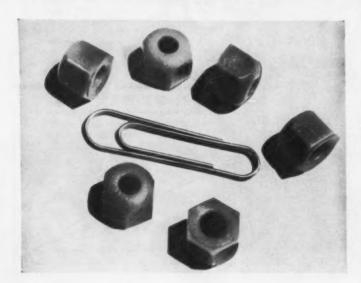
sistance to water and organic chemicals. They are nontoxic and odorless, lightweight, abrasion resistant, and smooth to the touch.

Nuts are available in No. 10 and 1/4-inch sizes. Since the nut forms its own thread as it is assembled, the No. 10 size fits both 10-24 and 10-32 threads, and the 1/4-inch size fits both 1/4-20 and 1/4-28 threads. Colors available are metallic gray to blend with aluminum; metallic gold; and natural (off white).

The nuts have a holding strength of 500 to 600 pounds under straight tension for the No. 10 size and 600 to 700 pounds for the 1/4-inch size. Prevailing torque is 8 to 10 inch-pounds for the No. 10 size and 10 to 14 inch-pounds for the 1/4-inch size, while stripping torque is more than 20 inch-pounds for the former and 25 to 30 for the latter size.

Carbides that Produce a Finish Comparable to a Ground Surface

A steel-cutting grade of hard carbides, specifically developed for high-speed and high-precision machining, and for finish machining hard alloys, has been announced by Kennametal Inc., La-



These small open-end lock-nuts, which form their own threads when assembled, are made of Du Pont "Delrin" for light-duty applications. trobe, Pa. The cutting-tool material, known as "Kennametal Grade K165," is available in throwaway inserts for all types of Kendex tooling. It has a titanium-carbide base and has good edgewear and crater resistance which greatly reduce "loss of size"—important in precision machining

and in finishing cuts.

Surface finishes of 12 rms or better (comparable with ground finishes) can be produced with this carbide because of its extreme hardness-strength property. The characteristics of this material permit machining high-temperature alloys that are low in machinability in terms of tool life. No special tooling or laboratory controls are required in finish machining many alloys such as stainless steels, tool steels, heat-treated alloy steels, and hard nonferrous alloys when it is used.

Compounded Cutting Oil for Critical Machining Operations

A compounded cutting oil for difficult or critical machining operations has been announced by Hal Industries, Box 224, Wyckoff, N. J. "No-Gall Cutting Compound," as it is called, is extremely effective in preventing galling of both cutting tools and work-pieces in such difficult operations as broaching, tapping, and threading. The compound is applied directly to the cutting-tool edges by brushing.

Reinforced Nylon Pressure Hose with Abrasion-Resistant Cover

Hose with a specially formulated nylon inner tube reinforced with high-tensile-strength yarn has been made available by the Polymer Corporation of Pa., 2140 Fairmont Ave., Reading, Pa. Known as "Nylaflow" pressure hose, it is one-fifth the weight and has a wall thickness less than one-half of rubber hose with equivalent burst-strength. The hose has an abrasion-resistant cover. It exhibits resistance to flex, pressure-pulse, and vibrational fatigue.

The hose is unaffected by flammable and non-flammable hydraulic fluids. While not recommended for use in mineral acids above 5 per cent concentration, it resists caustics and almost all organic solvents. It is nontoxic, noncorrosive, fungus resistant, and will not embrittle in storage. The hose retains flexibility and toughness in temperatures as low as minus 65 degrees F., and can operate constantly in temperatures up to 200 degrees F. and intermittently in temperatures as high as 300 degrees F.

Two types of hose are presently available with recommended maximum operating pressures of 1250 and 2000 psi (5000- and 8000-psi burst-strengths, respectively). Inside diameters are: 1/8, 3/16, 1/4, 5/16, 3/8, and 1/2 inch.

The product was designed for applications such as hydraulic, lubrication, fuel and oil, hot paint, solvent, water, Freon, and high-pressure pneumatic and CO₂ lines.

Silver-Solder Alloy Preclad to Metal for Brazing

Numerous composites of silver or noble-metal solder alloys clad to base or precious metals are now available in sheet, strip, and foil form, according to Texas Instruments, Inc., Metals & Controls Division, 34 Forest St., Attleboro, Mass. Fabricating parts from materials that have solder alloy preclad to the brazing surface eliminates the separate fabrication of small pieces of solder and the handling of these pieces during the brazing operation. The clad metal decreases the number of surfaces to be cleaned and fluxed, and also insures uniform wetting of the surfaces to be joined. Composites (other than the stainless steels) can be fabricated to 0.500 inch thick by 20 inches wide. Solder-clad stainless steel's maximum gage is approximately 0.062 inch thick by 10 to 12 inches wide.

High-Strength Steel for Aerospace Industry

A high-strength steel, called "Unimach UCX2," that was developed specifically for high performance rocket-motor cases for missiles, has been announced by Universal-Cyclops Steel Corporation, Bridgeville, Pa. It is a modification of AISI 4100 series type steel through the addition of cobalt as an alloying element.

The steel exhibits yield strength levels of 225,000 to 235,000 psi. When properly tempered to above strength levels, the alloy shows essentially no susceptibility to notch sensitivity. It has good forming characteristics and good weldability which facilitate the fabrication of parts.

Chemical-Resistant Epoxy Tooling and Repair Compounds

Two epoxy tooling and repair compounds have been announced by the Devcon Corporation, Danvers, Mass. The two are "Devcon 100"—a putty-like material, and "Devcon 101"—a liquid.

Both materials have good tensile and compressive strength, resist most chemicals and oils, and will bond to all types of metals, wood, ceramics, and other materials. They have been used for repairing damaged machinery, foundry patterns, and core boxes, and for other applications where high strength and light weight are important factors. They have also been used for making patterns, dies, core boxes, holding fixtures, and other tools.

Talking With Sales Managers



BERNARD LESTER
Management Consulting Engineer

How Will That Meeting Rate?

YOU will probably hold more group meetings this year then ever before. Fresh designs, new sales and service plans, and new markets will account for the usual quota of meetings. How can group meetings best be used as an instrument to build profitable sales? This is a relevant question.

Some of us hold meetings in an attempt to solve problems. There is a prevalent notion that "getting the bunch together" will produce muchneeded new ideas. Since we worship "togetherness," there is even danger that holding a meeting will be an end in itself. These aims may take precedence since many meetings provide a pleasant outing for some at company expense, even though a few must "work their heads off."

The meeting alone seldom solves problems or develops new ideas, although it may provide ground work for doing so. Nor is a meeting a place to make policy decisions. The majority vote often means compromise influenced by politics.

Meetings are costly. The expense record for travel and facilities does not tell the whole tale. Hidden expenses—planning, absence from regular work, preparation of elaborate minutes (often later left to gather dust) can easily exceed the direct costs.

From an opinion study of several group sales meetings, four criticisms stand out:

1. The discussion: "dominated by a few chaps who enjoy talking."

Weak leadership: "got nowhere," "was not buttoned up," "several times the meeting got sidetracked," and "attention lagged."

 Facilities inadequate: "projector got stuck," "miserable ventilation," "accoustics poor," and "noisy location."

4. Lack of preparation: "the talk just rambled around" and "the outside speaker did not fit into our work of our crowd."

In spite of these hazards, group meetings can have enormous power to create sales and reduce sales costs. What can be more important than to inform, inspire, and integrate? A meeting can give sales direction and improve sales quality and tone in a way never to be accomplished through the multiplying use of written words.

Since the sales department meeting offers real opportunities for profit or loss, it deserves most careful planning and execution, especially now. Consider each of these points: purpose, time and duration, location, facilities necessary, formal and informal program, leadership and speakers, and general participation and its control.

From the experience of several machinery sales managers, the following suggestions may help improve group-meeting efficiency.

Since the meeting is often prompted by tradition or custom, proclaim its specific purpose and goal. In this way you can measure progress.

Time the meeting right. In launching a new design or a new policy, a meeting too early or too late can be a calamity. Plan the length of a meeting as you do a speech. It should reach an effectual point, then stop. If it continues too long, the audience loses interest.

A change of location and scene gives healthy variety. Select a place where there is some opportunity for relaxation but not one where attention is likely to be diverted by side interests.

Friction most commonly occurs from poor facilities or failure in the implements of display. Inspection, trial, and rehearsal are extremely important.

Variety and surprise spice any program, but don't let them crowd out serious business. Leave the circus to the hucksters. Though work may be made a serious sport, amusement should be separated from business.

Select the outside speaker who has a direct message fitted to your men, not one who says nothing well. One college insists that the commencement speaker be a week-long campus guest early in the spring.

Select for the leader of the meeting a man who can get others to act and also maintain control. Good leaders establish goals, then lead toward them.

Stage each meeting to spark participation by the less articulate and demonstrative men. The sales meeting that counts is an educational experience for all who attend. It combines stimulation and freedom with constraint.

Press Forming Tools Made Without Machining

A novel gas deposition process, developed by the Budd Co.'s Carbonyl Metal Products Division, Conshohocken, Pa., permits press tools, forming dies, and other complex precision elements to be made from pure nickel. While it might be assumed that pure nickel would be prohibitively expensive for dies and similar members, the savings in benching costs and wear life make nickel-carbonyl dies highly competitive. This is true from the first-cost standpoint as well as operational cost

THE RESULT of four years of research aimed at the production of better forming dies for use in Budd's own metal-stamping business, the new die-shell deposition process has wide application in the field of metalworking, as well as in the rubber, plastics, and glass industries. The nickel portion of one of these dies resembles the gold cap or crown for a tooth.

In addition to the time- and cost-savings resulting from the elimination of machining, patterns and dies made of Budd nickel-carbonyl have exceptional advantages not matched by any other type of material or process, regardless of the complexity of the part.

Nickel-carbonyl dies and permanent-mold patterns are tough (Brinell hardness, 181-122). They work-harden under impact. For example, one pattern for a large automotive manufacturer has made over 100,000 impressions during 75 per cent of the production year without appreciable wear.

Nickel-carbonyl is 100 per cent pure nickel and has a melting point of 2600 F. Tensile strength is 85,000 to 95,000 psi, and ductility is high (elongation, 15-20 per cent). In addition, it has extremely high thermal shock properties (up to

1600 F.), permitting rapid cooling or quenching, which is impossible with cast irons or steels. Working temperature should be kept below 1400 F. Nickel-carbonyl has virtually no porosity, and actually becomes brighter and smoother in use. But a photomicrograph of the surface bears little or no resemblance to familiar wrought nickel.

In drawing or forming dies, nickel-carbonyl has little or no adhesion to steel or similar metals, therefore it does not "cold-weld" on impact—there is no "pickup" or galling between the die face and the stock. Consequently, no scoring of the work can occur, even under extreme conditions of draw and edge pressures. Another advantage is that no lubricants are necessary with nickel-carbonyl dies, thus eliminating the need for special equipment and subsequent cleaning of stampings after forming.

A "transferring" or molding technique, the carbonyl process duplicates with extreme accuracy every detail of the original master. Because of its excellent ductility, toughness, and work-hardening capabilities, nickel-carbonyl provides patterns and dies of extremely long life. In severe service an outstanding characteristic is

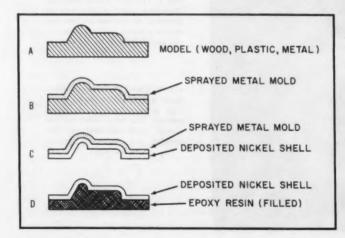


Fig. 1. Progressive steps followed in making pure nickel die shells from an ariginal master (wood, plaster, plastic, or metal pattern, die, or mold) using the nickelcarbonyl process.

its ease of maintenance and repair. The material is easily welded using acetylene or arc-welding techniques. The metal is also one of the easiest materials to braze (or silver-solder) and, in addition, it takes lead-tin soldering very well.

Nickel-carbonyl patterns and dies, Fig. 2, can be made in a wide range of dimensions, from about 1 by 1 up to 60 by 100 inches. There is no limit to the degree of complexity of shape or surface configuration. The more complicated the piece, the lower the cost as compared with conventional machining and hand-finishing techniques. The nickel shell can be made to any desired thickness, depending on the design and the type of application.

The Budd Co. is marketing only the end products of the new carbonyl-metal process which are nickel shells or molds with which to form or mold various metal or nonmetal parts or products. The die-making process starts with a master, Fig. 1-A,

in either wood, plastic, or metal.

After the master has been inspected and treated with a release agent, it is sprayed with a special eutectic-tin alloy until a rigid mold is built up (Fig. 1-B) to about 1/2 inch thick. This "negative" of the original master is then removed. The negative mold, with its inner or mold surface facing up, is then placed in a sealed depositing chamber. All of the atmosphere in the chamber is removed and replaced with inert carbon dioxide, Fig. 1-C.

The negatives are next heated within the chamber to between 325 and 340 F., when nickel-carbonyl gas, Ni (CO)₄, is introduced.

It is characteristic of nickel-carbonyl that when its vapor is raised above 280 F. it decomposes into

free nickel and carbon monoxide. Since the temperature of the molds in the chamber is well above this critical point, this reaction now takes place. Carbon monoxide is released, and the original nickel in the nickel-carbonyl gas is deposited molecularly on the heated surface of the molds. The thickness of the nickel deposited is directly proportional to deposition time, which may vary





Fig. 2. (Above) Nickel-carbonyl stamping punch shell made by gaseous deposition in the operator's hands will be fixed to the punch backup by an epoxyresin interlayer.

Fig. 3. (Left) Eutectic-tin alloy mold is built up by metal spray over a wood, plastic, or metal master. The more intricate the design and dimensions, the greater are the cost savings to the user.



Fig. 4. Metal permanent-meld cores for automotive castings are unusually accurate made by the nickel-carbonyl process. They require no machining and have several times the wear life of conventional cores.

from a few hours to several days depending on the application. Commercial shell thickness may range from 0.050 to 0.400 inch, but for most applications it is about 0.125 inch, and this depth of deposit is reached in about twenty-four hours.

Finally, the nickel-coated mold is taken from the depositing chamber and the eutectic-tin mold is removed, leaving a shell of pure nickel in the form of a "positive" reproduction of the original master, accurate in every dimension and detail.

Frequently this nickel "positive" goes to the customer as a hollow shell, Fig. 1-D. However, depending on the application, it may be filled with epoxy resin mixed with iron or aluminum fiber, and a steel backing plate added. The backing plate provides space for lifting bolts or mounting fixtures. A variation of the sequence is necessary if the customer sends a "male" mold and requires a "female" counterpart, or vice versa. In such cases an intermediate step between A and B (Fig. 1) is necessary. Here an epoxy-plastic "negative" of the original master is spray-coated with the eutectic compound followed by steps C

and D of Fig. 1. In this case the end result is a nickel negative of the original master.

Applications of the Budd Carbonyl Metal Process in terms of end products are many, encompassing every manufacturing operation or industry that uses forming or drawing dies, holding sections of trim dies, jigs and fixtures, permanent molds (Fig. 4), core boxes, and patterns. The biggest single application at the present time is in the automotive field where the company is currently producing dies and expendable foundry equipment items, including patterns, core boxes, die-cast molds, permanent molds, and shell molds. Typical products produced with nickelcarbonyl molds are: body stampings, fuel pump bodies, torque converter and transmission housings, bell housings, differential housings, cylinder heads, exhaust manifolds, brake drums, and carburetor parts. In addition to applications in the automotive stamping divisions of the Budd Co., nickel-carbonyl press tools are in use at the Ford Motor Co. and Fisher Body Division of General Motors Corporation.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

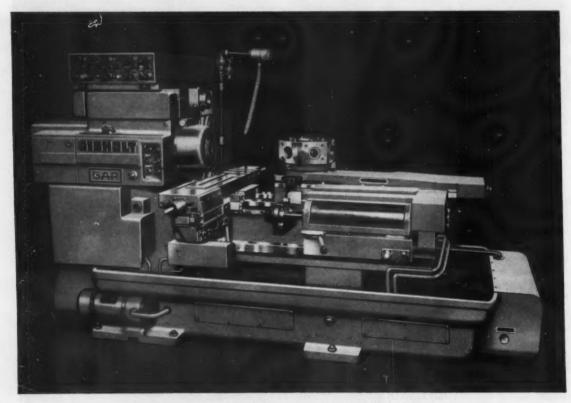
Gisholt Ram Type Turret Lathe

An automatic ram type turret lathe introduced to the metalworking industry by the Gisholt Machine Co., Madison, Wis., incorporates many new developments in machine tool design. An outstanding feature of this machine is its ability to handle both bar and chucking work at high-production rates, even when operated by inexperienced personnel. Called the Gisholt "Masterline AR" turret lathe. 'A' for automatic and 'R' for ram, it is basically a standard ram type turret lathe which has been transformed into a fullfledged automatic lathe.

Two models are available-the

4AR with a 2-inch bar-stock capacity and the 5AR with a barstock capacity of 2 1/2 or 4 1/2 inches. Except for an infinitely variable feed range of 1/4 inch to 120 inches per minute for the hexagon turret ram and the crossslide, these machines are similar in capacity and operation to the standard, manually operated ram type turret lathe. Construction features such as automatic lubrication, constant oil temperature, bedways with a 64-66 Rockwell C hardness, and headstock gear trains are also the same.

According to the manufacturer, the AR turret lathe combines automatic cycle efficiency with the versatility and quick setup features of the hand-operated machines. Except for cycle programming, which can be learned by an experienced operator or setup man in a day, setup is the same as for the standard equipment. The machine can be preset for spindle-speed selection (sixteen available) and such machine functions as: back-feed; right- or left-hand threading; and cross-slide, collet-chuck, and bar feed operation. Special or unusual functions such as the operation of a turret-mounted JETracer slide tool may also be incorporated into the automatic cycle.



Automatic ram type turret lathe announced by the Gisholt Machine Co.

IN

SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

Standard tools, already available in most shops, are used. There are no new tool-setup methods to learn, no cams or gears to change. All setup work is done from the front of the machine, no more time being required than for the hand-operated ram type turret lathe. For example, change-over from bar to chucking work, or vice versa, takes less than one hour. This makes the AR lathes particularly useful on small-lot as well as on long-run production work.

Cross-slide operation is entirely independent of the hexagon turret movements. The side carriage can be positioned longitudinally on the bed to suit the work. The cross-slide can be programmed to operate while the turret is waiting at the fully withdrawn or back position and it can operate simultaneously with the turret or after the turret comes forward. It can also continue to operate while two or more turret stations perform other work such as taking long facing cuts.

A second electrical control station on the headstock includes settings for threading by die heads or taps, dwell time (zero to twelve seconds) for each hexagon turret face and cross-slide station, reverse feed for the cross-slide, and timing for periodic drill withdrawal for chip-clearing action on deep-hole work.

The automatic cycle of this lathe reduces the operator's job to chucking the work, starting the cycle, and removing the finished part. On bar jobs even less work is required. Thus, the operator can easily handle a second machine to obtain added savings. The automatic cycle permits these lathes to be operated by inexperienced personnel while providing optimum tool life and consistent quality at fixed production rates.

Circle 565 on Readers' Service Card

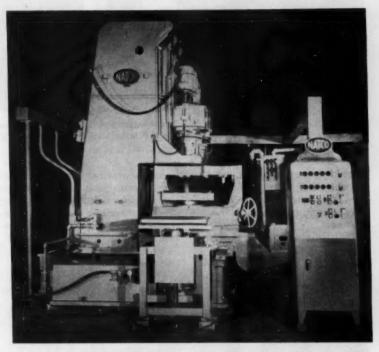


Fig. 1. Tape-controlled machine for processing flywheel housings built by National Automatic Tool Co., Inc.

Special Tape-Controlled Machine Designed to Process 160 Different Flywheel Housings

The National Automatic Tool Co., Inc., Richmond, Ind., has brought out a special tapecontrolled machine for processing the starter mountings in 160 different flywheel housings. Processing of these housings, Fig. 2, consists of boring the starter pinion hole and drilling and tapping the mounting holes. Hole locations are held to plus or minus 0.005 inch. The machine turns out a finished part every three and one-half minutes or less. The work-piece, a flywheel housing, such as shown in Fig. 2, is used on a series of diesel engines employed extensively in various industrial, marine, and trucking applications. While the part itself is simply constructed, different engine models on which it is used require about 160 versions in cast iron and aluminum. The starter pinion hole, surrounded by three mounting bolt holes (outlined in Fig. 2), is located in a different spot on the periphery of the casting in many of the versions. Furthermore, the starter bolt holes have different orientations around the central pinion hole. These parts are made in job lots of only 50 to 500 housings; thus the machine cannot be set up for long production runs.

In Fig. 3 is shown the punched tape which controls the location of the work-table and the feeding sequence of the drill heads. The

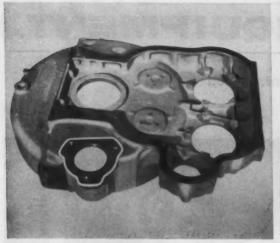




Fig. 2. (Left) One of 160 different versions of flywheel housings processed on machine shown in Fig. 1. Fig. 3. (Right) Punched-tape control of machine shown in Fig. 1

short tape loop contains the entire operating instructions for one part. This tape is easy to prepare directly from blueprints, and easy to store.

Tool equipment of the machine is shown in the close-up, Fig. 4. The boring and center-drilling head is shown on the left, the drilling head in the center, and the tapping head at the right. The operator orients the three outer spindles around the center of each head, setting them at the proper angle according to the ring dials at the top.

As a new run of housings comes up to the machine on a conveyor, the operator identifies the part, slips the proper tape in the reader, and rotates the spindle heads to the proper setting. A flick of a valve and the housing rises on an elevator into the ma-

chining position. Then the tape takes over, guiding the part through the full machining sequence. Thus, true short-run automation is obtained, with numerical control doing a job for which it was specifically designed.

Circle 566 on Readers' Service Card

Selas Introduces Automatic Heat-Processing Equipment

Automatic and semi-automatic gas-fired equipment for brazing and soldering, heat-treating, heating for hot-working, and selective hardening operations was exhibited at the tool show by the Selas Corporation of America, Dresher, Pa. On exhibit was an operating unit composed of Selas combustion components arranged to demonstrate brazing and soldering, heat-treating, and selective hardening. The components involved included the "Duradiant" burners, which are gas-fired and generate high-intensity radiant heat for controllable fast heating without flame impingement. "Superheat" burners, which produce high heat release to localized areas of workpieces (with flame temperatures up to 3000 degrees F. and blast velocities up to 2500 feet per second, using only standard commercial fuel gas and air) were included. Another component is the "Flo-Scope," for indicating flow rates of air and gases during confined travel, with minimum pressure drop, through piping at moderate temperatures.

A combustion controller, which takes natural gas or similar commercial fuel gas from a low-pressure plant line, draws air from

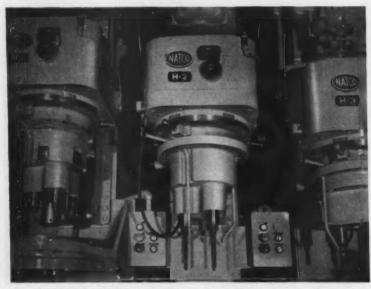
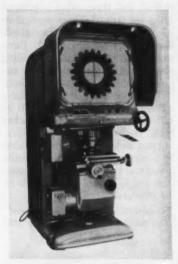


Fig. 4. Tool equipment employed to process part shown in Fig. 2.

the room, and compresses the mixture to several pounds pressure, for delivery to the burners, was also included in the equipment demonstrated. Also included was the automatic fire check, a combustion safeguard which localizes and extinguishes flash back.

Circle 567 on Readers' Service Card



Large-screen optical comparator introduced by Nikon, Inc.

Nikon Large-Screen **Optical Comparator**

A large-screen optical comparator was introduced at the recent Tool Engineers Show by Nikon, Inc., New York City. Designated the Model 5A, the new comparator has an 18- by 22-inch screen, and the illumination brilliance and edge-to-edge sharpness of the company's smaller models.

The 5A comparator, which features a telecentric four-lens turret, has a two-motor focusing system, with one motor for fast-motion coarse focusing and the other for fine focusing. Both motors are instantly reversible. Cutout microswitches at the extreme travel limits of the carriage automatically shut off the motors.

As with other Nikon comparators, the 5A has facilities for surface and contour measurements and inspection. Accessories available include cross-moving and revolving micrometer stages, holding fixtures, protractor screens, charts, and photo accessories.

Circle 568 on Readers' Service Card

Brown & Sharpe Deep-Hole Drilling Machine

A revolving drill type deep-hole drilling machine has been developed by the Brown & Sharpe Mfg. Co., Machine Tool Division, Providence, R. I. This machine is designed to provide flexibility, simplicity of setup, and economical production of accurately drilled parts. It utilizes the builtin advantages of rapid work-positioning and simplified tooling possible with knee type construction and eliminates the need for expensive and cumbersome fixtures normally required for accurate location of holes.

The machine is built in capacities for drilling holes from 1/8 to 1 inch in diameter, with a 12- or 24-inch feed stroke. Spindle speeds and feed rates suitable for a wide range of work are available. Other features include: rapid advance and return; vertical and longitudinal positioning with handwheel and crank calibrated to 0.001 inch: 28-inch longitudinal, 12-inch transverse,

and 12-inch vertical travel; and a high-pressure coolant unit delivering up to 30 gallons per minute and up to 2000 psi with filtering capability of 5 to 10 microns, built-in heat exchanger, and reservoir. A unique zero-setting gage permits fast and accurate location of the table and work-holding device in relation to the axis of the drill spindle.

Optional, extra-cost equipment includes a step pulley for providing three spindle speeds, variable-speed drive for infinitely variable spindle speeds, power travel in all directions, adapters for angular holes, drill heads with mechanical feeds (pick-off change gears) and drill heads with mechanical feeds having variable spindle-speed transmission and pick-off change gears, 24-inch feed stroke, and optic setting arrangements for vertical and longitudinal positioning within 0.0002 to 0.0003 inch.

Circle 569 on Readers' Service Card



Revolving drill type deep-hole drilling machine developed by Brown & Sharpe Mfg. Co.

Snyder Programmed Tool for Processing Aluminum Missile Wings

A programmed tool or machine that performs a variety of milling, drilling, and tapping operations on cast aluminum-alloy missile wings has been built by the Snyder Corporation, Detroit, Mich. This machine has a production rate of seventeen pieces an hour when operated at 100 per cent efficiency.

Basically, it is a line-index type tool in which the missile wing is clamped in a fixture that is traversed on hardened and ground ways to various machining positions. In machining the part, the work fixture is moved by a hydraulic cylinder arrangement along a 68-inch-long path.

Welded bases, arms, and columns for several different types of moving and fixed machining units are bolted to the machine base. The fixture is located by shot-pins for machining operations in intermediate positions and by stops at each end of the travel. Some machining operations are carried out while the fixture is being indexed from one position to the next.

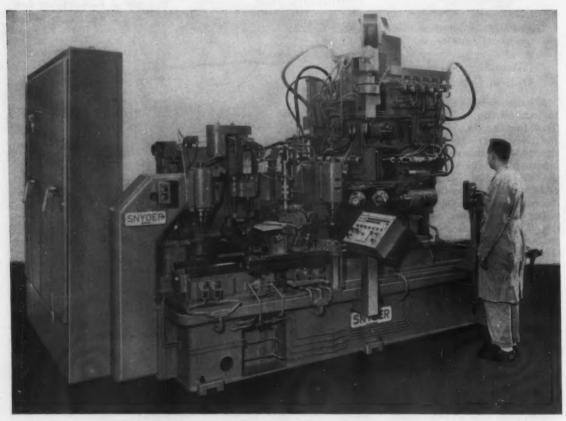
Eleven different machining operations are performed at five fixture positions on the missile wing by an assortment of machining units including a Snyder standard way type unit, two air-powered motorized drilling units, two motorized three-spindle drill heads, a two-spindle motorized tapping unit, nine motorized precision spindles, four air-powered, air-fed, single-spindle drilling units, and three air-powered, air-fed, lead-screw, single-spindle tapping units.

The tool is loaded at the left of the push-button control panel, which can be seen in the illustration. When the cycle button is pushed, the fixture traverses to the left-hand stop position where a slot and a step are milled in the work by two motorized precision spindles. Then the fixture is indexed to successive positions for completion of the machining operations.

At one station a vertical slide travels upward to three positions in which the following operations take place: two vertical holes are tapped; three horizontal holes are drilled; and three other horizontal holes are tapped. These operations are carried out by a motorized, two-spindle tapping head, three individual air-powered drilling units, and three individual, air-powered lead-screw tapping units.

The programmed tool occupies a floor space approximately 176 by 120 inches and is about 132 inches high. Hydraulic power for indexing and slide operation is provided by a separate motorized hydraulic pump and tank unit. Electrical controls are in a panel at the side of the machine.

Circle 570 on Readers' Service Card (This section continued on page 168)

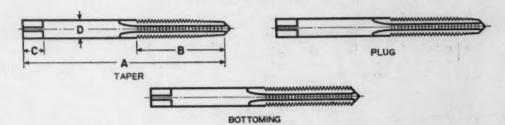


Snyder special line index milling, drilling, and tapping programmed tool for processing aluminum missile wings at a production rate of seventeen pieces per hour

AMERICAN STANDARD CUT AND GROUND THREAD TAPS-11

Regular Machine Screw Taps

Carbon Steel—Cut Thread High-Speed Steel—Cut Thread High-Speed Steel—Ground Thread



General Dimensions

								Number of Flutes		Dimensions				
Size	Basic Major							Optional	Length	Length	Length	Diam-	Size	
Size	Di am-	Car	Carbon Steel High-Speed Steel Stand- Ground Overal	Overall Of Of eter of Square Shank			eter of Shank							
	eter	NC UNC	NF UNF	NS	NC UNC	NF UNF	NS	ard	Thread	·A	В	C	D	E
0	0.060		80			80		2		1 %	%	3/16	0.141	0.110
1	0.073	64	72	56	64	72		2		111/16	3/4	1/16	0.141	0.110
2	0.086	56	64		56	64		3	2 2	1 3/4	1/16	1/16	0.141	0.110
3	0.099	48	56	.:	48	56		3	2	1 13/16	1/2	3/16	0.141	0.110
4	0.112	40	48	32,36	40	48	36	3	2	1-1/4	1/2	3/16	0.141	0.110
5	0.125	40	44		40	44		3	2	1 18/16	×.	3/16 3/16 1/4 1/4	0.141	0.110
6	0.138	32	40	36	32	40		3	2	2	11/2	3/16	0.141	0.110
8	0.164	32	36	40	32	36		4	2 or 3	2 1/8	3/	1/4	0.168	0.131
10	0.190	24	32	30	24	32		4	2 or 3	2 %	3/4	1/4	0.194	0.152
12	0.216	24	28	32*	24	28		4		2 %	15/16	1/32	0.220	0.165
14	0.242	1		20,24			20,24	4		2 1/2	1	%2 %2	0.255	0.191

All dimensions are given in inches.

*NEF_UNEF

These taps are furnished with standard number of flutes in taper, plug, or bottoming style.

Ground Thread taps having an optional number of flutes are furnished in plug or bottoming style only.

High-speed steel taps are furnished as follows: Cut thread No. 3 to 14, incl.

All Ground thread taps have external center on thread end.

All Ground Thread taps, except No. 14, have external center on thread end.

For thread limits and tolerances see

Tolerances*

			Tolerance		
Element	Range	Direction	Cut Thread	Ground	
Length Overall (A) Length of Thread (B)	0 to 14 incl. 0 to 12 incl. 14	Plus or Minus Plus or Minus Plus or Minus	3/22 3/44 3/44	3/52 3/44 3/48	
Length of Square (C) Diameter of Shank (D)	0 to 14 incl. 0 to 12 incl. 14	Plus or Minus Minus Minus	0.004 0.005	%2 0.0015 0.0015	
Size of Square (E)	0 to 14 incl.	Minus	0.004	0.004	

All dimensions are given in inches.

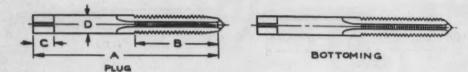
⁹For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet, published in February, 1980, page 186.

Extracted from American Standard Taps-Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

AMERICAN STANDARD CUT AND GROUND THREAD TAPS-12

Regular Machine Screw Taps

Oversize High-Speed Steel—Ground Thread



General Dimensions

Size	Basic Major Diameter						Dimensions					
		Threads per Inch		Number of Flutes		Length Overall	Length	Length of	Diam- eter of	Size		
		NC UNC	NF UNF	Standard	Optional	A	Thread B	Square	Shank	Square		
6 8 10	0.138 0.164 0.190	32 32 24	32	3 4 4	3	2 2 1/4 2 3/4	11/ ₁₈	3/28 3/4 3/4	0.141 0.168 0.194	0.110 0.131 0.152		

All dimensions are given in inches.

These taps are furnished in plug or bottoming style only.

Oversize taps are made .002* larger than the H3 limits

All taps have external center on thread end.

Tolerances*

Element	Range	Direction	Tolerance	
Length-Overall (A) Length of Thread (B) Length of Square (C) Diameter of Shank (D) Size of Square (E)	6 to 10 incl.	Plus or Minus	3/4	
	6 to 10 incl.	Plus or Minus	3/4	
	6 to 10 incl.	Plus or Minus	3/3	
	6 to 10 incl.	Minus	0.0015	
	6 to 10 incl.	Minus	0.004	

All dimensions are given in inches.

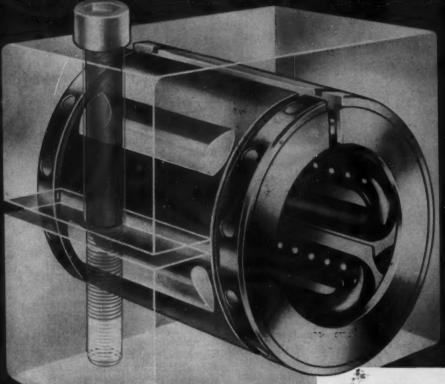
^oFor eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet, published in February, 1960, page 186.

Extracted from American Standard Tape-Cut and Ground Threads (ASA B5 4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

NOW!

Adjustable Diameter and Open

THOMSON BALL BUSHINGS





Precision Series "A" and Low Cost Series "B" BALL BUSHING



Open BALL BUSHING for Zero Clearance on Supported Shafts

Adjustable Diameter BALL BUSHING for Zero Clearance

LOW FRICTION - ZERO SHAKE OR PLAY ELIMINATE BINDING AND CHATTER SOLVE SLIDING LUBRICATION PROBLEMS LONG LIFE - LASTING ALIGNMENT

Also manufacturers of NYLINED Bearings . . . Sleeve Bearings of DuPont NYLON



The BALL Bearing for all your

LINEAR MOTIONS

Sliding linear motions are nearly always troublesome. Thousands of progressive engineers and designers have solved this problem by application of BALL BUSHINGS on guide rods, reciprocating shafts, push-pull actions, or for support of any mechanism that is moved or shifted in a straight line.

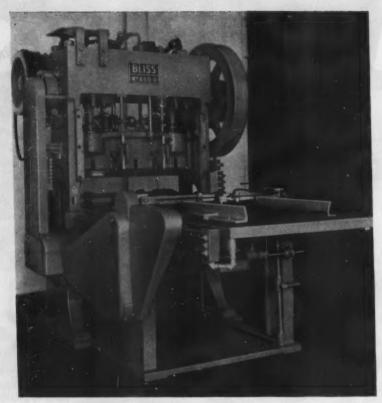
Improve your product! Up-date your design and performance with Thomson BALL BUSHINGS!

The various types cover a shaft diameter range of 1/6" to 4". Small sizes available in Stainless Steel. Write for literature and name of our representative in your city.

THOMSON INDUSTRIES, Inc.

Dept. G. MANHASSET, NEW YORK

PROGRESSIVE MANUFACTURERS USE BALL BUSHINGS-A MAJOR IMPROVEMENT AT A MINOR COST



Multiple-die press for large quantity production of screw caps, tape cans, and similar products announced by the E. W. Bliss Co.

Bliss Multiple-Die High-Production Press

The E. W. Bliss Co., Canton, Ohio, has announced a multiple-die press for large quantity production of screw caps, tape cans, shoe polish cans, and similar items. An entire lithographed sheet of tin plate or aluminum can be fed to the multiple dies to produce eight, ten, or even more caps at each stroke. The operating speeds generally employed for this kind of

work range from 100 to 125 strokes per minute.

This press is built in two sizes. The smaller model, 660D, can produce eight 48- or 53-mm caps at each stroke. The larger model, known as 6100B, produces ten 70-mm caps per stroke or a correspondingly lower number of larger caps.

Circle 571 on Readers' Service Card

Flaw-Alarm Accessories for "Sonoray" Ultrasonic Pulse-Echo Flaw Detectors

Three new flaw alarms for electronic monitoring are now available as accessories for "Sonoray" ultrasonic pulse-echo flaw detectors built by Branson Instruments, Inc., Stamford, Conn. Test signals which appear within preset limits are detected by the flaw alarm to actuate recorders or warning devices. Also, the alarm signal may

be used to initiate corrective action automatically.

A flaw alarm lets the operator pay closer attention to materials under test, instead of constantly having to watch the cathode-ray tube. He refers to the Sonoray screen only when evaluating defects noted by the alarm.

Each new flaw alarm has a

single time gate which is adjustable for position, length, and duration. The alarm may be turned on or off without disturbing work in progress or changing the settings of the Sonoray. All three flaw alarms have two outputs in common. The first is a red defect-indicator light mounted on the Sonoray front panel. The other is a 5-volt direct-current (noload) signal fed through a coaxial connector on the back panel, which will trigger audible alarms or markers, or start corrective action. It can also be used to actuate a simple go-no-go recorder.

A remote warning-light outlet forms part of the indicator-light circuit. Remote signals are particularly useful for complex tests requiring the operator's full concentration. For convenience, the remote light can be attached to the test probe itself.

The Model A flaw alarm, a passreject indicator, consists of the two standard outputs, a panel light, and direct-current signal. The Model B differs in one major respect: It also has a variable direct-current output, proportional to size of flaw and the signal in the alarm gate of the cathode-ray tube. Therefore, when connected to a pen recorder, a Model B flaw alarm logs the amplitude of any defect above a



Fig. 1. Fastermatic automatic



Accessories for Branson "Sonoray" flaw detectors

previously set discriminator level. For high-speed scanning, the Model C flaw alarm is recommended. It permits recording of flaws at the pulse-repetition rate which may be varied by the operator, from 100 to 600 pulses per second in the standard instrument. If desired, a higher pulse-repetition rate—200 to 1000 cycles per second—is also available, at no extra cost.

With suitable preamplifiers and data plots, the Model C flaw alarm provides a permanent record of all defects found. For example, when inspecting plate type nuclear-fuel elements, flaw detectors, with Model C alarms will indicate lack of bond between fuel elements, and will permit plotting these defects on a plan-view recorder. The same apparatus may also be used for inspecting brazed honeycomb structures and recording presence or absence of bond.

Circle 572 on Readers' Service Card

Gisholt Fastermatic Automatic Chucking Turret Lathe

The Gisholt Machine Co., Madison, Wis., has announced a "Masterline 3F Fastermatic" automatic chucking turret lathe. As with the previous 1F and 2F models, the 3F is designed to combine fast, easy setup with completely automatic operation. The operator need only chuck the work, start the automatic cycle, and remove the completed part.

Operating controls of the 3F machine (Fig. 1) are grouped on an angle-mounted panel at the left of the chuck, on the front of the headstock. These include controls for cycle start, spindle jog, chuck-unchuck, coolant, and machine on-off. A selector switch permits manual operation of additional machine-function controls for setting up. The hollow hexagonal turret,

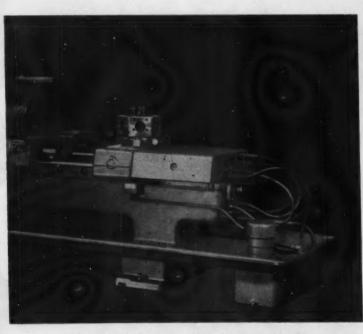
mounted on a massive saddle, performs the same work as that done on a manually operated fixed-center turret lathe. Turret indexing completes preset electrical circuits for the next turret station's operating cycle, including speed changes.

The front and rear cross-slides are designed to operate either independently or together with any or all hexagonal turnet stations. The rate of cross-feed is the same as for the working hexagonal turnet station. Accessories such as the turnet facing attachment, a lead-screw threading attachment, and a "JETracer" slide tool are available for use on this machine.

A close-up of the selector-switch control panel, Fig. 2, shows the six horizontal rows of selector switches, one row for each face of the hexagonal turret. There are ten vertical columns for separate machine functions. This permits fast, easy pre-selection of machine functions and speeds by simple shifting of toggle switches.

Job record sheets, that indicate the correct selector-switch positions for recurring lots, further reduce setup time and skilled labor requirements. This selector-switch control panel is standard on Gisholt Masterline 1F, 2F, and 3F Fastermatic automatic chucking turret lathes, and is said to cut setup time 50 per cent.

(Continued on page 172)



chucking turret lathe announced by Gisholt Machine Co.

When you talk about the

<u>BETTER</u> MACHINE TOOLS

you'll talk about

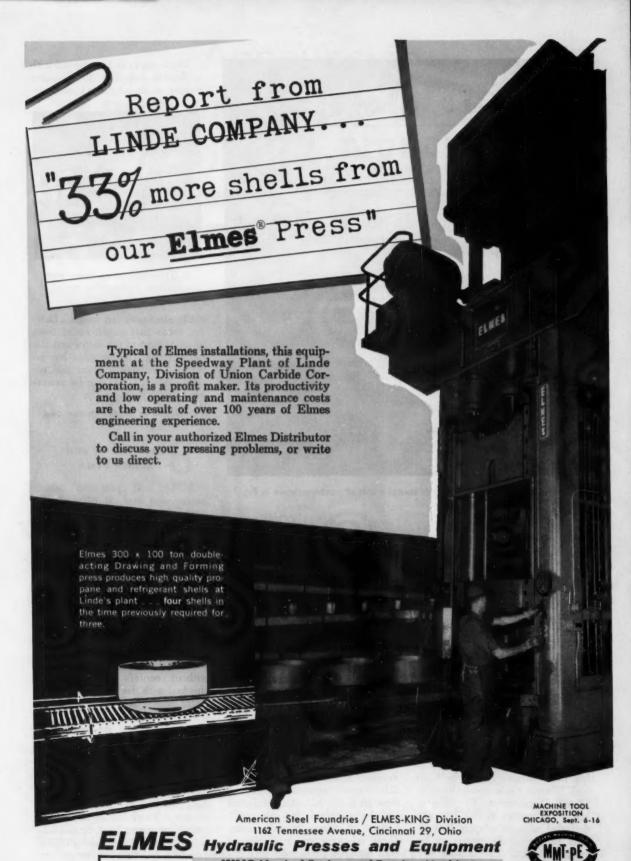


VERTICAL BORING AND TURNING MACHINES

HYDRAULIC PRESSES AND EQUIPMENT

for Metalworking, Plastics Molding, Custom-designed Applications.

American Steel Foundries ELMES/KING DIVISION, Cincinnati 29, Ohio



MACHINERY, May, 1960

For more data circle this page number on card at back of book

KING Vertical Boring and Turning Machines



Fig. 2. Close-up of selector-switch control panel of machine shown in Fig. 1

At the top of the headstock, above the selector-switch control panel, is the flow-control feed system. Feeds are pre-selected for each turret station by simple dials on meter-out-control valves, mounted on the headstock. There is one valve for each turret station. Infinite feed-rate adjustment for each station is easily made by turning the corresponding dial. The desired rate of feed is quickly

set by reference to a feed-rate meter, at the left, on the headstock. This further refinement cuts setup time another 50 to 60 per cent, and permits pre-selection of all feeds and speeds in less than fifteen minutes, for most work. This reduces the setup man's job to actual tool setting and the normal trial cuts, common to the setup of any manual or automatic lathe.

Circle 573 on Readers' Service Card

General Electric Line of Hydraulic Pump Motors

A line of hydraulic pump motors in NEMA frames 182 through 215 has been introduced by the General Electric Co.'s Small Integral Motor Department, Ft. Wayne, Ind. The motors in this line are designed with an adapter that allows the hydraulic pump to be motor-mounted. The motors are available in drip-proof, enclosed,

or explosion-proof construction. They are made in all ratings now supplied in the 182, 184, 213, and 215 frames, nominally from 1 through 5 hp. Mounting adapters can be supplied for use with pumps of many manufacturers. These adapters are available on both ends of drip-proof and enclosed nonventilated motors.

The motors can be supplied with a flexible coupling that assures proper shaft alignment and vir-



G-E hydraulic pump motor with adapter for mounting pump

tually eliminates any unusual bearing loads that might result from misalignment of the motor and the pump shaft. The coupling has no rubbing surfaces to wear and requires no grease. It can be assembled easily and quickly.

Circle 574 on Readers' Service Card

Bench Center and Surface Plate

A low-cost precision bench center and surface plate designated Model BC3 has been introduced by the K. O. Lee Co., Aberdeen, S. Dak. This equipment is designed to provide an accurate means for inspecting all types of work. Work-pieces can be mounted between centers, in V-rests or on precision-ground surface plate. Runout is shown on a dial indicator as the work is rotated by hand. Side runout or camming action can be checked with a second indicator. Parts without centers can be easily checked with the work-holding Vrests which are furnished as standard equipment.

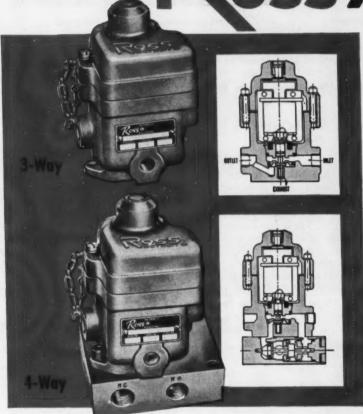
Tailstocks can be positioned any place on the T-slot. They are rigidly mounted on the base with top and side lock. The tailstocks are ground in pairs, assuring that both centers are exact height from the plate. The B922R quick-release tailstock has an adjustable setting for spring load. Spring adjustment can be made without changing relation of center to

(Continued on page 174)

Announcing

a new and better solenoid valve in the $\frac{1}{8}$ and $\frac{1}{4}$ size range

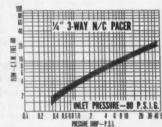




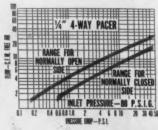
More life More speed More capacity More value

Now you can have about three times more flow capacity-to-solenoid size than in most competitive valves. Needs just 7 watts of power yet minimum internal orifice size is full # .. The PACER has short poppet travel, will cycle at better than 1000 cpm and meets JIC specifications. Lightweight, cast aluminum body means 3-way weighs just 20 ounces, 4-way just 28. Dust tight, liquid tight, can be manually actuated, has captive cover, is inoperative with cover removed, has integral wiring space. Why not test a PACER in your own circuit, just \$18 for a 3-way, \$26 for a PACER 4-way. Call your Ross representative or write for Bulletin 319.

Pressure drop thru 3-way N.C. Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shown as a range rather than as absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



Pressure drop thru both N.C. & N.O. sides of 4-way Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shows ranges for each side rather than absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.

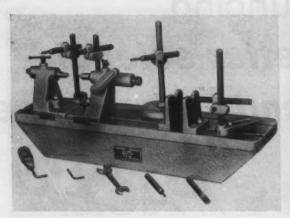




Ross

OPERATING VALVE COMPANY

110 EAST GOLDEN GATE AVE. . DETROIT 3, MICH.



Lee precision bench center and surface plate



Atrax solid-carbide wire-size drill blanks

work. Work can be placed in position or removed easily with the use of the quick-release lever. The centers are of alloy steel, hardened and precision ground. (Carbide centers are available at extra cost.)

Use of the unit is not restricted to one indicator. Four indicator stands are standard and can be positioned any place on the surface plate. The dial-holding rod can be clamped at any height and angle and used on either side. Dial indicators are not furnished with this unit. The distance between centers is 22 inches; centerline height from centers to plate, 4.130 inches; diameter of work over surface plate, 8 1/4 inches;

and length of base, 28 inches. The net weight is 125 pounds.

Circle 575 on Readers' Service Card

Solid-Carbide Drill Blanks

The Atrax Co., Newington, Conn., has added to its line of precision-ground solid-carbide cutting tools an 1825 series of wire-size drill blanks, numbers 1 through 80. These blanks are precision-ground from the solid in grade C-2, to tolerances of plus 0.0000 to minus 0.0005 inch. The complete range of diameters runs from 0.0135 to 0.2280 inch.

Circle 576 on Readers' Service Card

Olofsson boring, turning, and facing machine

Production Boring, Facing, and Turning Machine

A newly designed, air-operated, cam-controlled stroke contouring machine, designated Model 41, has been added to the line of precision boring and special machinery manufactured by the Machinery Division, Olofsson Corporation, Lansing, Mich. This machine is designed for production boring, turning, contouring, and facing operations such as required in machining tapers, grooves, undercuts, and chamfers. Operations may be performed alone or in any combination of sequences.

A 4-inch cam-controlled stroke is available on both the main-slide and cross-slide. The cams are mounted on the same shaft. Both the table-slide and cross-slide are in direct contact with their respective cams, and all machine functions are electrically interlocked. Air at a pressure of 80 to 120 psi is required to operate machine.

The base of the Model 41 machine is of one-piece, fine-grain nickle-iron construction. Hardened and ground vee- and flat-ways are used on main slide, and hardened dovetail ways on cross-slide.

The supply tank of the lubrication system is cased integrally with the base and operates automatically during each cycle. Cams and cam followers are completely submerged in oil. The cams can be quickly changed by raising the cross-slide, which is double-keyed to the base in both directions.

Circle 577 on Readers' Service Card

NOW DIMENSIONAL TOLERANCES CAN BE HELD ON HARDENING TYPE AQ 400 HARDNESS RINELL 300 CONVENTIONAL CAST IRON 200 AS AS 200 400 600 800 1000 1200 CAST QUENCHED DRAWING TEMPERATURE "F Type AQ Mechanite castings, hardened in air, experience considerably less loss in hard-ness when subjected to elevated temperatures than ferrous castings hardened by conven-tional means.

NEW AQ MEEHANITE® . . . keeps distortion to a minimum

AQ Meehanite® is a tough, wear and abrasion resisting material which can be cast to a machinable hardness and air hardened after machining to high Brinell values with little or no distortion, even in massive castings. An outstanding advantage of this new metal is its ability to be locally hardened for improved wear resistance. As no water quenching is required, few stresses are produced and dimensional tolerances can be held closely. This is particularly important for such parts as dies, punches, cams, rollers, etc.

Type AQ Meehanite is ideally suited for hot forming dies and other parts required to work at elevated temperatures because

it maintains its high hardness even when heated. For this reason, AQ Meehanite castings can be expected to provide good wear resistance where conventional flame hardened parts may soften under repeated temperature influence. See chart above. Large castings can be fully hardened . . . simply . . . economically . . . without oil bath equipment . . . and without dangerous distortions.

Free literature is available on AQ Meehanite. Write to the Meehanite Metal Corporation or contact the nearest Meehanite foundry.

You'll like doing business with a Meehanite foundry.

MEEHANITE METAL

The American Laundry Machinery Co., Rochester, N. Y. Atlas Foundry Co., Detroit, Mich. Banner Iron Works, St. Louis, Mo. Barnett Foundry & Machine Co., Irvington, N. J. Casting Service Corp., LaPorte, Indiana and Bridgman, Michigan

Centrifugally Cast Products Div., The Shenango Furnace Co., Dover, Ohio

Compton Foundry, Compton, Calif.
The Cooper-Bessemer Corp.,
Mt. Vernon, Ohio and Grove City, Pa.

Crawford & Doherty Foundry Co., Portland, Ore. Dayton Casting Co., Dayton, Ohio Empire Foundry Co., Tulsa, Okla. Florence Pipe Foundry & Machine Co., Florence, N. J. Fulton Foundry & Machines Co., Inc., Cleveland, Ohio

General Foundry & Mfg., Flint, Mich. Georgia Iron Works, Augusta, Ga. Greenlee Foundries, Inc., Chicago, Ill.

Hamilton Foundry Inc., Hamilton, Ohio Johnstone Foundries, Inc., Grove City, Pa. Kanawha Manufacturing Co.,

Charleston, W. Va.
Kennedy Van Saun Mfg. & Eng. Corp.,
Danville, Pa.

Lincoln Foundry Corp., Los Angeles, Calif. Oil City Iron Works, Corsicana, Texas Palmyra Foundry Co., Inc., Palmyra, N. J. The Henry Perkins Co., Bridgewater, Mass. Pohlman Foundry Co., Inc., Buffalo, N. Y.

Rosedale Foundry & Machine Co., Pittsburgh, Pa.

Ross-Meehan Foundries, Chattanooga, Tenn. Sonith Foundries of FMC, Indianapolis, Ind. Standard Foundry Co., Worcester, Mass.

The Stearns-Roger Mfg. Co., Denver, Colo, Vulcan Foundry Co., Oakland, Calif. Washington Iron Works, Seattle, Wash.

Dorr-Oliver-Long, Ltd., Orillia, Ontario Hartley Foundry Div., London Concrete Machinery Co., Ltd., Brantford, Ontario Otis Elevator Co., Ltd., Hamilton, Ontario

MEEHANITE METAL CORPORATION, NEW ROCHELLE, NEW YORK

Fairbanks Nº 1

a scale, our first one. an imagination of iron, brass, copper and lead, fashioned in a New England workshop. inanimate.

but it spoke—
a different kind of language,
of pounds and ounces and fractions thereof
and it spoke only the truth.

it felt the roundness of grain, the smoothness of marble, the sweetness of candy and the authority of gold.

il heard—
the sound of life, babies newborn
it cradled them and recorded their growth
until pounds and ounces were replaced
by years and months.

it traveled by packet boat down the Mississippi, by clipper ship to England, The Sandwich Isles, the Indies, South America and China. better known throughout the world than anything else made in America.

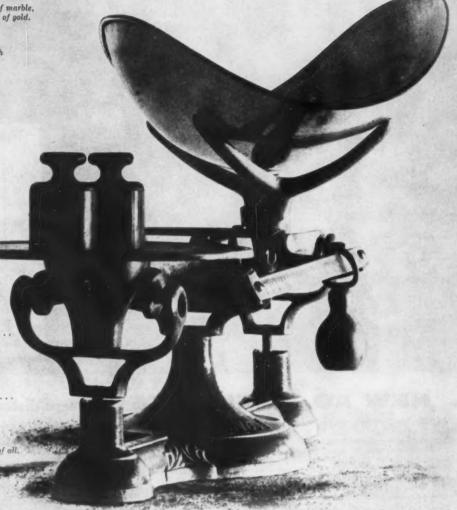
it was relied on by farmers, merchants, scientists and doctors, it witnessed history; influenced it and was part of it.

its descendants have new names. floazial dial, mercoid switch, reed switch and cotton lap; remote control, printomatic, electronic and levetronic and all serve to evaluate and control the substances that make up the universe.

raw materials or manufactured articles; things unseen or man himself; all have weight and must be measured . our scales do the job.

and the new challenge—weight in motion . . .
freight trains in transit,
trucks too busy to stop,
tiquids coursing through miles of pipe . . .
our scales will do the job.

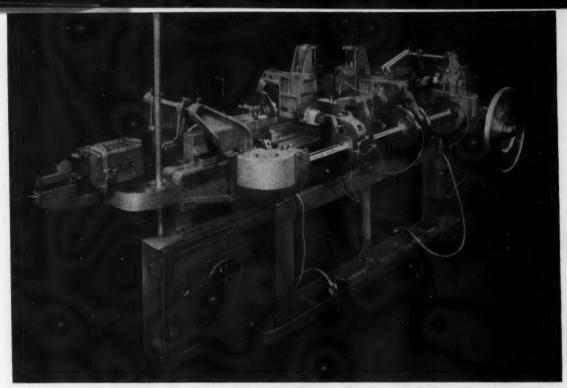
but this was our first—
Fairbanks No. 1
and we hold it in special reverence
for it weighed the most precious thing of it weighed an idea.



Fairbanks, Morse

Scales for heavy industry and for business; scales for science and for the home. Scales that weigh milligrams or millions of pounds. Scales that weigh missile fuel loads at Cape Canaveral; trucks on the Golden Gate Bridge; onions at your neighborhood grocer's . . . we make every kind of scale for every kind of purpose, including electronic scales. We are the Number 1 manufacturer of scales and automated weighing systems in the world.

If you have a problem where the careful calculation of weight is of vital importance, please write to Mr. Robert W. Kerr, President, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.



Duplex Multi-Slide machine of new line announced by the U. S. Tool Co., Inc.

U. S. "Duplex Multi-Slide" Machine

The first of a line of U.S. "Duplex Multi-Slide" machines has been announced by the U.S. Tool Co., Inc., Ampere (East Orange), N. J. The Duplex is, in effect, a double-ended machine. In other words, material (stock from coils) can be fed in at both ends-one strip feeding in the left-to-right direction and the other in the right-to-left direction. This arrangement is ideally suited for the fabrication of assemblies which could include two stampings (both made and assembled in the machine) or two stampings (both produced in the machine) assembled with a prefabricated, hopperfed member. Also, the equipment can be used for making two entirely different stampings (not requiring assembly) at the same time.

If required, the Duplex could also be employed in the manner of a standard U. S. Multi-Slide machine by using one end only to feed material from one side only. The Duplex Multi-Slide offers the user almost unlimited possibilities for the manufacture of stampings and assemblies within the capacity range of the machine.

This equipment can accommodate material up to 3 inches in width. The feed length is adjustable up to a maximum of 6 inches.

Standard equipment includes: a feed mechanism, stock straightener, and stock check at each end; die head (ram at each end); and one common four-slide forming posi-

tion including stripper with double motion. The machine is equipped with an automatic lubrication system, air-operated clutch-brake mechanism, and 7 1/2-hp variablespeed drive

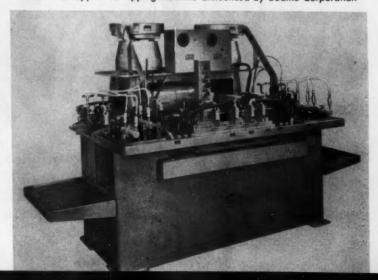
Circle 578 on Readers' Service Card

Bodine Continuous Tapping Unit

A continuous automatic tapping machine, announced by the Bodine Corporation, Bridgeport, Conn., is said to provide an effective solution to the problem of production time loss that is ordinarily unavoidable in the withdrawal of taps

from the work. The new machine solves this problem by the use of a double-ended, lead-screw type spindle with special high-reversal motor drive, so arranged that the tapping operation at one station is coincident with the withdrawal

Automatic hopper-fed tapping machine announced by Bodine Corporation



of the tap at the opposite station. With automatic hopper feed from above at each end of the spindle, there is essentially no waste motion and no lost production time.

The welded-steel base of the machine contains electrical controls, coolant pump, and reservoir, as well as chip and work receptacles. The spindle is mounted centrally on the work-table, with unusually spacious areas at each end for tooling. The basic machine is designed for mounting vibrating type work feeders on a shelf above the spindle, feeding by track to

each tooling area. As options, large floor type feeders, magazine feeders, or manual loading may be used to meet tooling requirements for tapping nuts, lock-nuts, tee nuts and odd-shaped parts.

The tapping spindle is an adaptation of the basic Bodine No. 52 lead-screw tapping spindle, arranged to move back and forth in the horizontal plane, driven by a special high-reversal motor of 2-hp rating, with capacity for handling taps to 1 1/4 inches in diameter. Multiple heads can be used.

Circle 579 on Readers' Service Card

"Tool Analyser" Designed for Accurate Control of Cutting Tool Angles and Shapes

To meet the increasing need for more accurate control of all cutting tool geometry, Stocker & Yale, Inc., Marblehead, Mass., have brought out an improved version of their "Tap Analyser." Originally intended for inspection and classification of taps, the new model, designated "Tool Analyser," will accommodate many other small tools including: drills, reamers, end mills, broaches, counterbores, hobs, etc. Several new features are said to make the instrument more versatile and faster in operation.

Precision measuring is accomplished by a monocular, zero-parallax optical system with magnifications up to 40×. The tool to be inspected is accurately chucked in relation to index, view angle, and dimensional scales. Readings to

0.0001 inch may then be taken. An important feature is that all readings are made at one setting—thus eliminating transfer errors. Shank tools are reference-marked on their shanks to assure identical positioning for all operations. Tool geometry, then, may be related to production results, affording more positive quality control.

The Tool Analyser will accommodate shank diameters from 0.006 inch to 1 3/8 inches with standard equipment, and provision has been made to remove the regular chuck head for replacement by the use of special fixtures (V-blocks, center supports, clamps, vises, etc.). Thus, the range of the instrument is further increased, and tools or work-pieces without shanks may also

be observed. A full complement of accessories including collets, chucks, arbors, and optics is interchangeable so that many tool sizes can be accommodated.

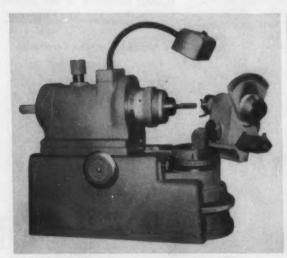
Circle 580 on Readers' Service Card

"Auto-Power" Hydraulic Power Package

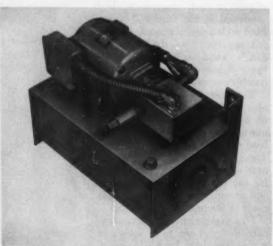
An economical hydraulic power package, designated "Auto-Power," that combines compact design with high-level lift ability has been developed for a wide range of industrial applications by the Autoquip Corporation, Chicago, Ill. Designed and constructed for dependable, maintenance-free service through long periods of time, this packaged unit provides 1 1/2-gallon per minute output at 2000 psi. This power is readily adaptable for press operation, machine feeds, lift tables, pushers, and punchers, or for any intermittent or jog-duty applica-

A precision gear pump is directly coupled to an electric motor of special design capable of producing up to 3-hp output at its duty rating. Also built-in are adjustable relief valves, ball check-valves, and removable-screen suction filters mounted on a 4 1/2-gallon oil reservoir. Optional accessories include a solenoid-controlled, one-way return valve with built-in, pressure-compensated flow control.

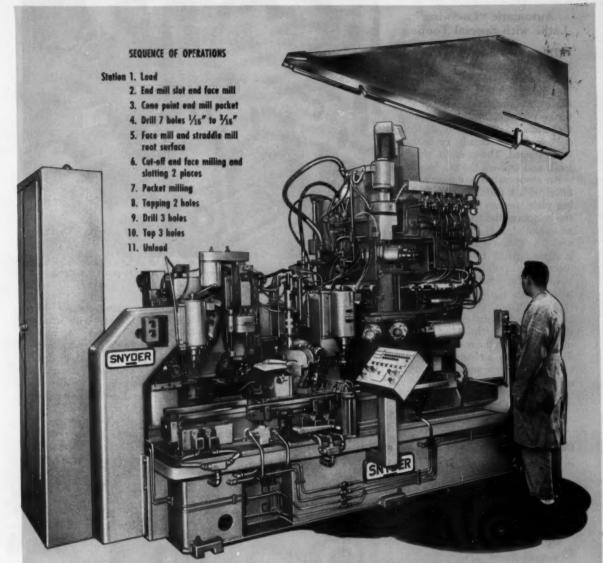
Circle 581 on Readers' Service Card (This section continued on page 180)



Stocker & Yale versatile precision "Tool Analyser"



Power package developed by Autoquip Corporation



COMPLEX MISSILE WING GETS 24 PRECISION OPERATIONS IN SPECIAL SNYDER PROGRAMMING TOOL

at Martin Company's Baltimore Division

Production rate, tolerances and part configuration dictated the fundamental design concept of this exceptionally compact tool which has 11 stations and performs 24 operations.

The cycle can be automatic, semi-automatic or manual. Controls for multiple cycle operations are provided by utilizing basic circuits triggered by a programming control device.

SNYDER

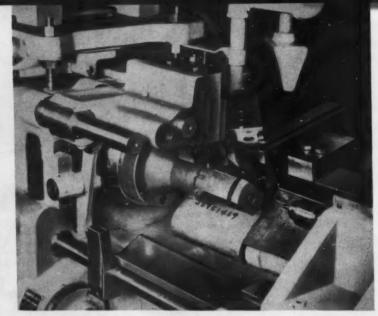
(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123

Automatic "Lo-Swing" Lathe with Special Tooling

The Seneca Falls Machine Co., Seneca Falls, N. Y., has equipped one of its Model "LR" automatic "Lo-Swing" lathes with special tooling to bore, face, chamfer, and turn a piston skirt while centering the closed end. Because all tools operate simultaneously, cycle time is minimized. The operator simply loads and unloads the machine.

An air-operated centering arbor, fitted with a spring-loaded centering plate, centers the piston from the bottom of the bore, while three air-operated jaws center the open end. The piston is held against the centering plate by action of an air-operated pull-bar and a pin introduced through the gudgeon-pin hole. When the piston has been clamped in position, boring, turning, and facing of the open end of the skirt is accomplished with tooling mounted on the overhead slide. Simultaneously a chamfer is made using a 45-degree squaring attachment, mounted on the rear of the



Seneca Falls automatic Lo-Swing lathe equipped to process pistons

lathe. A motor-driven center drill mounted on the carriage slide centers the closed end of the piston. All tools operate simultaneously and a high hourly production is obtained.

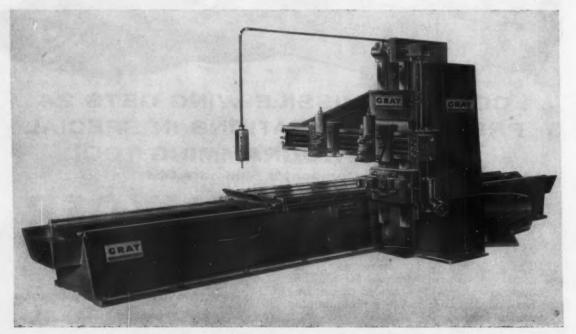
Circle 582 on Readers' Service Card

in nine combinations of table widths and heights—basic sizes are 30, 36, and 42 inches. The rugged components of this machine are engineered to resist torsional deflection and vibration under the heaviest of cuts in either direction.

The wide face on the column, the rail, and the rail heads are all square-locked. This square-lock design is said to rigidly resist the forward and reverse thrusts produced in double cutting. The new

Planer Designed for Fast Two-Way Cutting

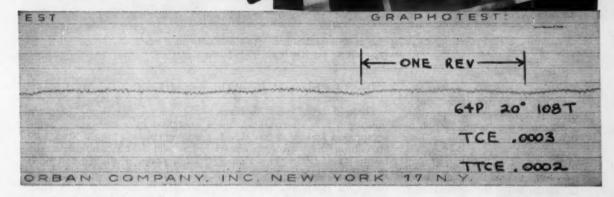
The G. A. Gray Co., Cincinnati, Ohio, is now building a small planer designed to combine outstanding productivity and low cost with high quality. Called the "Gray Flying Scot," it is available



Gray Flying Scot planer designed for cutting in both directions

why General Mills checks every precision production gear on the S&F gear tester...

production gear in one of four S & F Testers. Note extreme sensitivity



because ...

there's no gear tester as accurate as the S & F

Checking gears by the usual methods just isn't accurate enough to satisfy so precision-minded a producer as the Mechanical Division of General Mills. They know that their gears can be only as accurate as the instruments that test them-and only the S & F Gear Tester measures up to the highest precision standards.

Strong statement you say? Several hundred S&F Testers prove it every day in plants that took their gear accuracy seriously enough to change over to S&F-guaranteed to repeat within .00001".

Ask us to show you why this instrument is revolutionizing gear checking. Or talk to the S & F user near you. We'll send you his name.



COMPANY, INC.

42 Exchange Place, Jersey City 2, N. J.



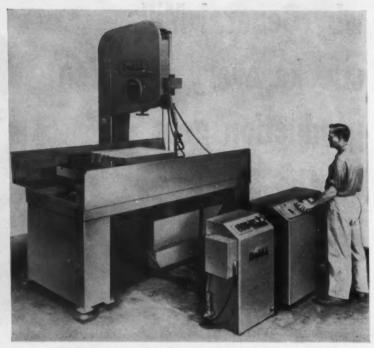


Fig. 1. (Left) Cutting slab of stainless-steel honeycomb on Electro band machine.
Fig. 2. (Right) Electro band machine brought out by the DoALL Co.

"Helicone" transmission (patent pending) is an unusually simple drive. It is self-contained, provides a smooth, nonpulsating motion to the table on long, as well as short strokes, and is ideal for carbide planing. The angled helical bull gear has a minimum of three teeth in mesh with the helical rack whose angle is such that there is no side thrust on the table.

The Flying Scot 60/75-hp, variable-voltage drive was expressly designed for this application. The constant torque motor is adjusted by rheostats on both the cutting and return strokes from 180 to 1800 rpm. The standard planer drive ratio is 6 to 1, which provides table speeds from 30 to 300 fpm. Controls are conveniently located in a pendent station affording complete control of table movement. No additional control levers are required. The planer is available with single- or doublecutting heads, or any combination of both. Also featured are two vee ways, infinite hydraulic feed range, nonshock pneumatic tool lifters, duplex tables, synchromesh table replacer, nonmetallic table ways, space-saver drive, etc.

Circle 583 on Readers' Service Card

DoALL "Electro" Band Quenched-Arc Cutting Machines

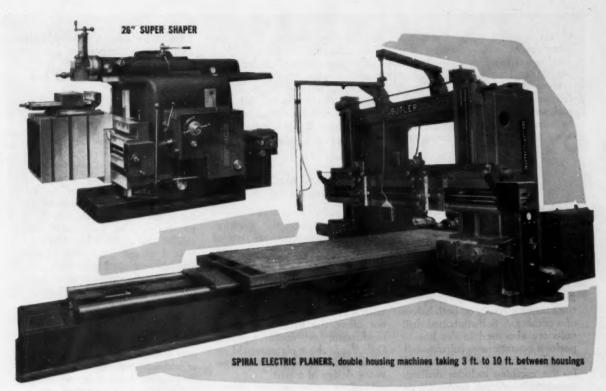
Three "Electro" band machines. utilizing a new electrical machining process known as "quenchedarc cutting," have been introduced by the DoALL Co., Des Plaines, Ill. This equipment is especially suited for machining honeycomb of aluminum, stainless steel, or titanium, and other fragile cellular structures made of foil or thin-wall tubing. Fig. 1 shows a slab of stainless-steel honeycomb being cut at the rate of 50 sq ipm (square inches per minute). As the name implies, Electro band machining is an extension of the band-sawing technique. It uses modified standard DoALL band machines, combining high-speed cutting and low material waste.

Work is sliced away by a band that removes as waste only 1/32 inch of material. Instead of making honeycomb core in rough individual blanks and grinding away waste material, it now is possible to start with a "log" and slice off pieces to finished size at substantial savings.

Quenched-arc cutting occurs when metallic material at ground potential is fed into a rapidly moving special saw band which is energized by a low-voltage, highcurrent power supply at a rate that will sustain an arc at the leading edge of the band. A flood of coolant limits or "quenches" the are and washes away the cutting swarf. When all factors are properly balanced, the resulting finish is equivalent to that produced by grinding. The cutting rate is comparatively high (5 to 50 sq ipm) for finely finished work and very high (150 to 200 sq ipm) where finish of the foil edge is not important. The flatness of the surface achieved ranges from plus or minus 0.003-inch true indicator reading at the lower cutting rates, to plus or minus 1/64-inch true indicator reading at the maximum rate of cut.

Because the actual cutting is accomplished by an electric arc, neither the work nor the cutting band are subjected to stresses that occur in sawing, grinding, or milling. Therefore, fixturing need be only strong enough to hold the work-piece in a vertical position without deflection.

All three Electro band ma-



LAPOINTE BUTLER

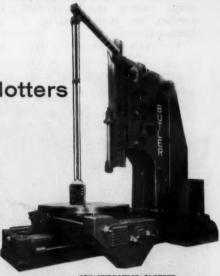
Precision Planers · Shapers · Slotters

For more than 90 years, the Butler name has been synonymous with precision planers, shapers and slotters, sold and used in all the important metalworking centers throughout the world.

Now available in the U.S., they have a tremendous advantage over all others... they are backed up by all the facilities of the large Lapointe plant in Hudson, Mass., including engineering and service personnel.

We invite serious comparison with any domestic machines of similar quality and precision. Feature-by-feature, you will find that these Lapointe BUTLER machines are at least their equal—and often superior. Not to be overlooked, of course, is the comparison of price.

Write today for literature and prices, Dept. M



42" HYDRAULIC SLOTTER

LAPOINTE MACHINE COMPANY

HUDSON, MASSACHUSETTS

Exclusive U. S. Agent for

ASSOCIATED BRITISH MACHINE TOOL MAKERS, LTD.











LANG PARKINSON WARD
Engine Lathes Millers, Goar Planers Turret Lathes

PRECISION MACHINE TOOLS

BUTLER CHURCHILL
Planers, Shapers, Slotters Grinding Machines

chines are completely self-contained units, each consisting of a fixed-speed band machine, power supply, and recirculating coolant system. Although a special band has been developed as the cutting tool, other types of band, as well as wire, can be used. The controls are simple and conveniently

mounted on the side of the machine column.

The power supplies for these machines range from 5 kw up and all have a voltage range of 6 to 24 volts direct current. All have power work-tables that are insulated from the machine frames.

Circle 584 an Readers' Service Card

Eleven-Station Transfer Machine for Processing Two-Piece Crankcases

Both halves of cast-aluminum automotive crankcases are processed through an eleven-station transfer machine designed and built by F. Jos. Lamb Co., Detroit, Mich., at the rate of 120 pairs per hour. This equipment has drill heads arranged to perform operations simultaneously on both halves of a crankcase. Self-contained drill units are also used in the line to perform operations peculiar to left or right halves. Work performed by the machine includes drilling. reaming, chamfering, probing, tapping, milling of bearing-lock notches, and straddle-milling of bearing bosses.

A 60-inch walking-beam type

transfer drive mechanism moves the parts through the machine. All machine components are of standard building-block construction. Coolant is piped from an overhead system directly into the bushing plates which are doweled to the fixtures to form an integral unit. A change in part design does not affect the fixtures, clamping mechanism, or coolant piping. Only the bushing plates would require modification to suit changes in the design of a part.

Machine movements are electrically interlocked to prevent operation should the part be incorrectly positioned or improperly clamped, or should malfunctioning occur from other causes. All hydraulic and electric components conform to IIC standards.

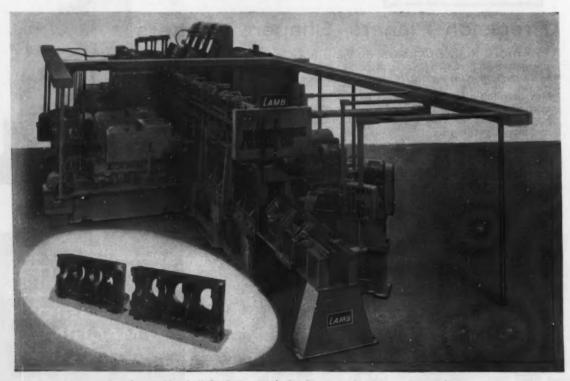
Circle 585 on Readers' Service Card

"Burr-Masters" Designed to Improve Gear Quality

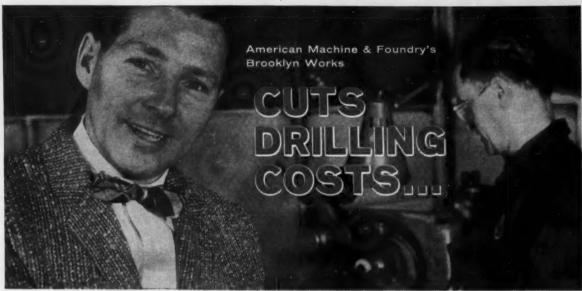
At the recent tool show, Modern Industrial Engineering Co., Detroit, Mich., showed tool and manufacturing engineers how they could use "Burr-Masters" to improve gear quality by demonstrating operating machines tooled for production jobs. Included in the exhibit was a Model BMHPT-14 hypoid pinion gear-tooth topper actually employed in finishing the top edges of hypoid gear teeth. A two-station Model BME-24CE machine was tooled to deburr and chamfer transmission cluster-gears. This standard machine showed how burring and chamfering of gear teeth can be done in a groove or undercut without tool interference during loading or unloading.

Also shown in operation was a two-station Model BMED-29S chamfering and topping machine.

Circle 586 on Readers' Service Card (This section continued on page 186)



Transfer machine built by F. Jos. Lamb Co. for processing automotive crankcases



Ralph Mazza, Foreman, Tool Grinding and Small Tool Department



At AMF, the Cincinnati SPIROPOINT sharpens spiral point drills for 10 radials, 60 sensitive drill presses and 20 multiple-spindle multiple head units.

"... 20% more holes per grind"

"... Hole size tolerances of .0015" to .002" on smaller diameters"

"... More than 15% less downtime on our multiplespindle drilling machines"

"... Less costly fixtures required"

By using Cincinnati SPIROPOINT® Drill Sharpener to apply the new *spiral point* geometry to standard twist drills, AMF reduces drilling costs right across the board—in time, tools, materials, maintenance.



Ask your Cincinnati Lathe and Tool Dealer about SPIROPOINT - or write to us direct.

CINCINNATI LATHE AND TOOL CO.

3207 Disney Street, Cincinnati 9, Ohio

"HYDRASHIFT" Lathes/"CINCINNATI" Drilling Machines/"SPIROPOINT" Drill Sharpeners

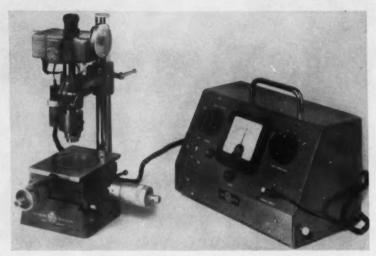


Photoelectric Microscope

The Engis Equipment Co., Chicago, Ill., has announced a photoelectric microscope designed to combine simplicity with fatigue-free sensitivity. This instrument has been developed to meet the needs of industry arising from the increased use of precision scales, microscopes and projectors in machine tools, dividing heads, rotary tables, and measuring machines.

The Microptic photoelectric microscope adds to its standard micrometer visual-setting eyepiece a patented photoelectric detector. This photocell detector registers a null reading on the electronic read-out meter when the scale graduation is truly central in the field of the calibrated slit. The microscope is housed in a tube 7 1/2 inches in length by 1 inch in diameter, and provides a total measuring range of 0.05 inch.

The instrument can be provided with a light source to illuminate the scale and can then be used to read graduations from 0.0001 to 0.0015 inch in width on any precision scale. The Microptic photoelectric microscope is so sensitive that relatively few repeated



Engis photoelectric microscope

observations are needed to achieve a given precision. It provides a basic unit for many high-precision testing operations which require speed yet reliable accuracy.

Circle 587 on Readers' Service Card

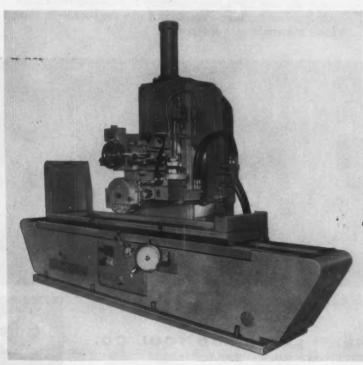
Tracer-Controlled Surface Grinder

A tracer-controlled, hydraulicfeed surface grinder, designed to automatically reproduce transverse forms on large pieces, has been introduced by Gallmeyer & Livingston Co., Grand Rapids, Mich. The tracer control is said to be particularly suited for use on forms that are too large for grinding with a single formed wheel and for materials requiring diamond wheels.

The machine is equipped with an automatic cross-feed and automatic down-feed. The automatic cross-feed, moving the wheel across the work, can be preset to feed from 0.008 to 0.040 inch at each table reversal and has a total travel up to the full width of the work table. The cross-travel automatically reverses and feeds the work in the opposite direction.

The automatic down-feed is used when the piece is so deep that it is not feasible to reproduce it in a single pass. Only a predetermined amount of material is removed from the piece each time the grinding wheel traverses the width of the work. The amount removed is adjustable from 0.0025 to 0.060 inch. An automatic stop permits presetting to maximum form depth. When this depth is reached the down-feed is automatically disengaged. These features make it economically feasible to grind forms in large pieces, particularly work of the new, harder, and difficult-to-grind materials.

(This section continued on page 204)



Gallmeyer & Livingston tracer-controlled surface grinder



A SERIES OF EDLUND CAM FEED UNIT MACHINES AT RAYTHEON PLANT.



EASY OPERATION FROM A SIMPLE PUSH BUTTON CONTROL STATION.

EDLUND CAM FEED UNITS SELECTED BY RAYTHEON FOR SPECIALIZED DRILLING

EDLUND CAM FEED UNIT MACHINES are designed to individual order. At RAYTHEON'S Missile Systems Division Plant. Andover, Mass., they are used on parts for the Hawk Missile. By utilizing specially constructed multiple heads with angular spindles-a New concept in this type of work-these machines accomplish difficult drilling, reaming, tapping, spot facing, and countersinking operations. Operating in any position, the units can be used in single or combination batteries. The infinite adaptations of EDLUND CAM FEED UNIT MACHINES pay off

in faster production and reduced drilling costs.

Send for Free Illustrated Bulletin

Edlund Representatives in Major Cities

EDLUND CAM FEED UNIT MACHINES FEATURE:

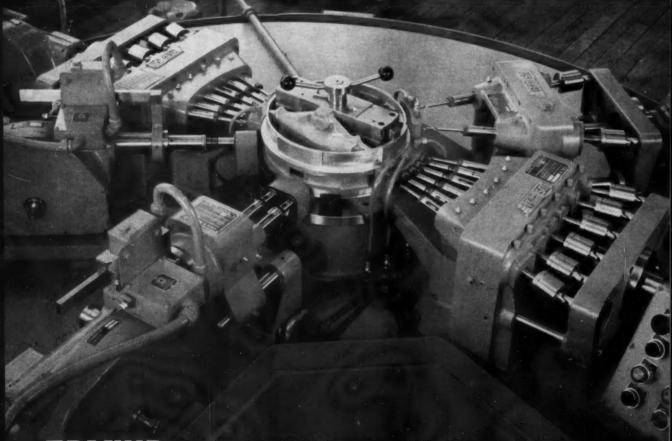
- 1. The Advantages of Positive Cam Feed.
- 2. One Man Operation-by Electric Control.
- 3. Speeds from 310 to 3800 rpm., and Maximum Cam Strokes of 21/4" (No. 62) and 3" (No. 125).
- 4. Adaptable to Angular Drilling Operations.
- 5. Simple Jig Set-up gives Precision Operation.
- 6. Numerous Drilling Operations can be Performed Simultaneously.

MACHINERY COMPANY.

Cortland, New York

Division of Harsco Corporation

EDLUND CAM FEED UNIT MACHINES DOING INTRICATE DRILLING DURING THE MANUFACTURE OF HAWK MISSILES



EDLUND CAM FEED UNIT MACHINES—ENGINEERED TO SOLVE YOUR SPECIALIZED DRILLING PROBLEMS

NEW CATALOGUES

• Yours for the asking. . . . Use postcard inside back cover



Metalworking Compound

D. A. Stuart Oil Co., Ltd., Chicago, Ill. Brochure giving composition and applications of "Hi-D" cutting fluid, a petrochemical compound possessing the high detergency of synthetics but none of their disadvantages. It reduces down time for wheel dressing.

Circle Item 501 on Inquiry Card



Diamond Grinding Wheels

Simonds Abrasive Co., Philadelphia, Pa. Bulletin (Form ESA-310), describing a line of diamond grinding wheels, featuring both man-made and natural diamonds. Grain and grade recommendations, operating data, and illustrations are included.

Circle Item 507 on Inquiry Card



Drilling and Threading Units

Snow Mfg. Co., Bellwood, Ill. Bulletin describing a line of drilling, tapping, and threading machines. Illustrations and typical applications are shown. These units are air-operated and electrically controlled. Automatic control is built-in.

Circle Item 502 on Inquiry Card



Stenciling Machines

Northeast Ohio Machine Builders, Inc., Columbiana, Ohio. Brochure describing function of completely automatic stenciling machines. The brochure explains, with diagrams, how they measure, weigh, and stencil the resulting data on pipe or bars.

Circle Item 508 on Inquiry Card



Aluminum Mill Products

Metals Division, Olin Mathieson Chemical Corporation, New York City. Booklet on the selection of aluminum alloys for any product that can be made of the light, corrosionresistant metal. It describes physical properties, etc.

Circle Item 503 on Inquiry Card



Bending Blocks

Acorn Iron & Supply Co., Philadelphia, Pa. Brochure featuring bending blocks or welding platens and tools and accessories, such as a gooseneck hold-down dog, tapered drift pin, bending post, and horizontal clamp. Single and multiple stands are available.

Circle Item 509 on Inquiry Card



Furnaces

Hevi-Duty Electric Co., Milwaukee, Wis. Bulletin 591, describing the complete range of nonferrous metal furnaces manufactured by the company. Illustrated are pot furnaces, crucible furnaces, double-chamber dry hearth furnaces, etc.

Circle Item 504 on Inquiry Card



Broaches

The du Mont Corporation, Greenfield, Mass. Catalogue on "Minute Men" keyway broaches and kits with which keyways can be cut by hand in one minute at low cost. Metric keyway broach sets and individual broaches and bushings are available.

Circle Item 510 on Inquiry Card



Special Tooling

Tool Products Corporation, North Tonawanda, N. Y. Catalogue No. U-95, describing Series "HD" (heavy duty) unitized tooling. This line of perforating units for mild steel up to a maximum of 1/4 inch in thickness features built-in lubrication.

Circle Item 505 on Inquiry Card



Impact Tester

Testing Machines, Inc., Mineola, N. Y. Brochure and data sheet describing TM1 motorized impact tester, which conforms to ASTM Standard E-23. It makes either the Izod (cantilever beam), Charpy (simple beam) or Tension Impact Test.

Circle Item 511 on Inquiry Card



Boring Mill

Consolidated Machine Tool Division, Farrel-Birmingham Co., Inc., Rochester, N. Y. Bulletin 1220, on the complete line of Farrel-Betts vertical boring mills ranging in capacities from a swing of 7 feet to 42 feet and larger. Specifications are given.

Circle Item 506 on Inquiry Card



Aluminum Alloys

All-State Welding Alloys Co., Inc., White Plains, N. Y. Manual giving a complete survey of aluminum welding, brazing, and soldering. Subjects covered are: welding aluminum and its alloys by inert-gas shielded metal arc with a consumable electrode, etc.

Circle Item 512 on Inquiry Card



BARNESDRIL HONING

IN YOUR MACHINING OPERATIONS...

Fast, accurate, economical metal removal to tolerances measured in tenths of thousandths... uniform finishes from 1 to 100 RMS... at production speeds. Barnesdril Honing Machines combine the advantages of geometric accuracy — axial straightness, diametric roundness, and diametric straightness — with metal removal rates comparable to grinding operations. Compensation for some wear, rapid tool expansion, hone feed, and tool collapse have been integrated as part of the machine function ... all blended into smooth, fast-reversal stroking by Barnesdril's exactingly engineered hydraulic drive system.

BarnesdriL Horizontal Honing machines range in size from Model No. 1 with capacity to 11' length to Model No. 36 for lengths up to 90'. Large capacities and fast metal removal rates make these machines ideal for honing commercial tubing. An additional BarnesdriL feature . . . short stroking at any point in the bore . . . insures a uniform bore size. Electric hone expansion provides continuous control of pressure and automatically compensates for stone wear.

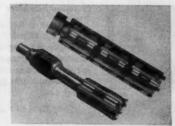
For fast, accurate metal removal . . . consider honing. And, by all means, consider BarnesdriL. We offer a complete line of Vertical and Horizontal machines in a wide range of sizes for internal or external honing. Write for catalog No. 550 TODAY!



Speed range and bone expansion can be adjusted electrically in seconds without leaving this conveniently located control panel.



Plugmatic gauging mechanism, a BarnesdriL exclusive, gives positive, automatic sizing from bore to bore on production work,



Barnesdril. engineers can select from a complete line of tools and abrasives to exactly suit your particular homing

BARNESDRIL



HONING MACHINES

Honing Machines / Production Units / Filtration Units / Drilling Machines

BARNES DRILL CO.

820 Chestnut Street • Rockford, Illinois
DETROIT OFFICE — 13121 Puritan Avenue

catalogues . . . bulletins manuals

· Yours for the asking. . . . Use postcard inside back cover



Indexing Drives

Ferguson Machine Corporation of Indiana, St. Louis, Mo. Catalogue No. 160, a compilation of standard roller gear drive indexing mechanisms, highspeed precision index-tables, in-line transfer machines, and allied equipment. Complete load ratings are given.

Circle Item 513 on Inquiry Card



Relays

General Electric Co., Schenectady, N. Y. Bulletin GEA-7021 discussing complete line of G-E relays for all applications. Relays included are general purpose, machine tool, mechanically held (latched-in), pneumatic timerelay and synchronous motor-driven.

Circle Item 519 on Inquiry Card



Steel Tubing

Ohio Seamless Tube Division, Copperweld Steel Co., Shelby, Ohio. Catalogue CS-60, describing both seamless steel and electric welded-steel tubing. Carbon and alloy steel grades of seamless tubing are covered in mechanical, aircraft mechanical categories, etc.

Circle Item 514 on Inquiry Card



Motor Coupling Line

Link-Belt Co., Chicago, Ill. Folder 2875, describing new features added to the line of MC geared flexible motor couplings. A new corrosive duty cover, made of polyproplene, has exceptional resistance to acids, alkalines, and solvents.

Circle Item 520 on Inquiry Card



Components

Northwestern Tools, Inc., Dayton, Ohio. Catalogue No. 30, presenting all standard components manufactured by the company, including the new quickacting hand knobs and quick-acting inserts. Jig and fixture components and step blocks and clamps are described.

Circle Item 515 on Inquiry Card



Carbide Brazed Tools

Wesson Co., Detroit, Mich. Bulletin No. MF-260, describing standard lines of carbide throw-away and "onend" inserts, blanks, and brazed single-point tools. Complete specifications are given on square, round, triangular, and diamond-shaped inserts.

Circle Item 521 on Inquiry Card



Lindberg Engineering Co., Chicago, Ill. Bulletin No. 260, describing and illustrating the full muffle hydrogen atmosphere hand pusher furnaces for bright hardening and annealing of stainless steels and other high-alloy materials

Circle Item 516 on Inquiry Card



Portable Air Tools

Rotor Tool Co., subsidiary of the Cooper-Bessemer Corporation, Cleveland, Ohio. Bulletin AR-1, discussing addition of the Rotor Model AR, "Airiter" to a line of portable air tools for all industry. The new tool is a marking device.

Circle Item 522 on Inquiry Card



Precision Machines

American Electronics Inc., Industrial Machinery Division, Norwood, Mass. Catalogue showing a complete line of autocycle machines for boring, turning, and facing operations. These units provide "50-millionths precision with pushbutton ease."

Circle Item 517 on Inquiry Card



Machine Accuracy

The Industrial Machinery Division, American Electronics, Inc., Norwood, Mass. Operational manual describing a line of single-, twin-, and opposedspindle boring, turning, and facing machines that feature push-button cycling. Specifications are included.

Circle Item 523 on Inquiry Card



Metal-Powder Parts

Market Development Division, New Jersey Zinc Co., New York City. Booklet entitled "Designing for Pressed Brass and Nickel Silver Metal-Powder Parts," prepared for design engineers and manufacturers considering the use of nonferrous structural parts.

Circle Item 518 on Inquiry Card



Time-Saving Devices

Lassy Tool Co., Plainville, Conn. Catalogue on time-saving devices, illustrating uses of the "multi-purpose" work-holder in three models for production and toolroom use; three models of hand tappers and accessories; a universal tap and die guide, etc.

Circle Item 524 on Inquiry Card



HOW MUCH COULD YOUR SHOP PRODUCE IN A TWO HOUR DAY...

... LESS A COFFEE BREAK?

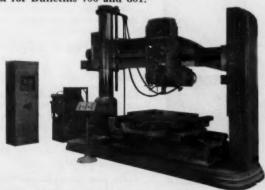


Almost as much as you now produce in 8 hours with conventional equipment! When you switch to an AMERICAN numerically controlled Positioning Table and the new AMERICAN Hole Wizard Radial Drill, your production will step up 400%!

In addition to fast, error-proof positioning to ± .000250", the AMERICAN positioning table gives you extreme ease of operation. The simply loaded punched tape is read by low pressure air, and automatically moves the table to first position at the touch of a button. After that, your operator need only touch the "Next Position" button on the portable console.

This rugged, profit-making combination was designed by American Tool Works and Sperry Gyroscope engineers to increase your production, eliminate expensive jigs, prevent operator error. Ask your American Distributor about "Toolease," our leasing plan under which this AMERICAN Positioning Table and AMERICAN Hole Wizard Radial combination can improve your production... while it pays for itself. Or, write Section 163 at the address below.

Ask for Bulletins 700 and 801.





THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE . CINCINNATI 2, OHIO

· Yours for the asking. . . . Use postcard inside back cover

CO. Welding Process

National Cylinder Gas Division. Chemetron Corporation, Chicago, Ill. Brochure on the company's "Dual Shield" carbon-dioxide welding process. It increases production, uses inexpensive CO2 gas, reduces rejects, and provides higher electrode efficiency.

Circle Item 525 on Inquiry Card



Compressible Devices

Taylor Devices, Inc., North Tonawanda, N. Y. Engineering Handbook CH, describing, with drawings and graphs, the simplicity of operation of patented Taylor "Liquid Spring Shoks" using liquid compressibility. It provides nomographs and formulas.

Circle Item 530 on Inquiry Card



Tubular Rivets and Nuts

Tubular Rivet & Stud Co., Quincy, Mass. Catalogue on TRS "Perma-Nuts." Drawings show how one-piece combination tubular rivets and nuts can simplify design and assembly where attachments or fastenings are involved.

Circle Item 526 on Inquiry Card



Resistance Welders

Taylor-Winfield Corporation, Warren, Ohio. Bulletin 8-413, describing 32 "multi-spot" and projection resistancewelding machines. Data include: type of operation, production rate, welding machine specifications, and materialhandling equipment.

Circle Item 531 on Inquiry Card



Philadelphia Gear Corporation, King of Prussia, Pa. Booklet entitled "An Advanced Concept in Modern Gears," describing the advantages in using hardened and precision ground gears. Request on company letterhead from Philadelphia Gear Corporation, Schuylkill Expressway, King of Prussia, Pa.



Recessing Tools

Maxwell Industries, Inc., Ashtabula, Ohio. Data File AT-61, to assist production engineers, machine tool designers, machine shop owners, and production personnel in solving precision internal machine problems. Five basic groups of tool-holders are presented.

Circle Item 532 on Inquiry Card



Grinding Spindles

Dumore Co., Racine, Wis. Bulletin No. DM59, containing all specifications, photos, and other details on new spindles which employ a new seal known as "Nilos Rings," completely sealing bearing from dirt, abrasives, and coolants.

Circle Item 527 on Inquiry Card



Countersinks

Cleveland Twist Drill Co., Cleveland. Ohio. Folder showing features of "new style" countersinks in four types. They make for easy feeding, long tool life, and burr-free holes and better finish. Recommended applications are given.

Circle Item 533 on Inquiry Card



Testing Systems

Tubular Products Division, Babcock & Wilcox Co., Beaver Falls, Pa. Chart showing approximate relation between hardness by various testing systems and tensile strength of carbon and alloy steels, Hardness systems covered: Brinell, Monotron, etc.

Circle Item 528 on Inquiry Card



Varied Equipment

The Ingersoll-Rand Co., Phillipsburg, N. J. Booklet (Form 223) for anyone interested in the selection and supervision of plant equipment. Standard reciprocating, axial-flow and centrifugal air compressors, and air and electric tools are all covered.

Circle Item 534 on Inquiry Card



Cylinders

Allenair Corporation, Mineola, N. Y. Form No. AS, introducing a line of air and hydraulic cylinders to be known as Type "AS." They are available in bore sizes of 7/8 inch, 1 1/8, 1 1/2, and 2 inches, as either doubleacting or spring-return.

Circle Item 529 on Inquiry Card



Socket-Screw Items

Standard Pressed Steel Co., Jenkintown, Pa. 82-page technical reference on industrial socket screws including both standard catalogue data and extensive design and performance information on a family of fasteners used in virtually all industries.

Circle Item 535 on Inquiry Card

Another addition to the famous "Greenfield" Line . . .

Greenfield

Tru-Lede

Fluteless Taps

Patent No. 8E. 24572

FOR

PRESSURE FORMING
INTERNAL THREADS

100

COPPER

BRASS

ALUMINUM

DIE CASTINGS

LEADED STEELS

and other ductile materials

TRU-LEDE fluteless taps do not cut
threads in the same manner
as conventional taps. Actually
they are a forming tool
and their action may be compared
with external thread rolling.
No problem of chip disposal as
there are no chips with this method.
Under proper conditions
and in the appropriate materials,
they are giving outstanding
results in hundreds of applications.

Ask your GREENFIELD Distributor for a copy of this 4-page pamphles. It contains the complete story: Sizes available, recommended limits, selecting the right tap drill, and other information you'll want to have.

GREENFIELD TAP &

GREENFIELD, MASSACHUSETTS

A Greenfield field engineer is available to talk ever your tapping requirements and to discuss how TRU-LEDE TAPS can help you. CALL HIM THROUGH YOUR GREENFIELD DISTRIBUTOR. · Yours for the asking. . . . Use postcard inside back cover



Motor Controls

Arrow-Hart & Hegeman Electric Co., Hartford, Conn. Folder on Type "RA" ("Right Angle") design starters and contactors. It defines the "RA" design principle and explains why magnetic motor controls of this design offer reduced size and weight.

Circle Item 536 on Inquiry Card



Broaching Fixtures

National Broach & Machine Co., Detroit, Mich. Revised catalogue (B60-1), describing Red Ring unitized broaching fixtures. It describes a variety of self-contained, air-powered broaching fixtures for producing keyways, slots, flats, etc.

Circle Item 542 on Inquiry Card



Resistance Welding

Taylor-Winfield Corporation, Warren, Ohio. Bulletin SP-18, with photographs of 268 welded products. Included are actual case histories showing how modern resistance welding machines are selected or specially engineered for particular needs.

Circle Item 537 on Inquiry Card



Shop Hygiene

Cincinnati Milling Products Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. Brochure entitled "Cimcool Machine Cleaner" (PC-355) describing how this product may be used. It also outlines how the cleaner can be used as a degreasing solution.

Circle Item 543 on Inquiry Card



Furnace Equipment

Sunbeam Equipment Corporation, Meadville, Pa. Bulletin covering a full line of industrial furnace equipment for heat processing. It includes a special selection guide for selecting the proper equipment in relation to particular heat-process requirements.

Circle Item 538 on Inquiry Card



Hydraulic Accumulators

Parker Hydraulics Division, Parker-Hannifin Corporation, Cleveland, Ohio. Bulletin 1530B1, explaining why and how accumulators are used in a wide variety of hydraulic systems. It includes descriptions of Parker piston type accumulators.

Circle Item 544 on Inquiry Card



Dry Abrasive Cutter

Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. Bulletin DH-299, describing the Model 2-A "Sever-All" dry abrasive cutting machine. This unit offers a fast, economical method of cutting solids, tubing, and structurals.

Circle Item 539 on Inquiry Card



Engineered Iron Castings

Hamilton Foundry Inc., Hamilton, Ohio. Brochure showing the engineering facilities and services used in the production of castings from a wide range of iron alloys. It also contains a comparative properties chart and description of different irons produced.

Circle Item 545 on Inquiry Card



Magnetic Contactors and Starters

General Electric Co., Schenectady, N. Y. Bulletin GEA-7020 containing information about G-E contactors and starters including combination, reversing and two-speed forms, and modification kits available. The booklet gives applications, installations, etc.

Circle Item 540 on Inquiry Card



Presses

Lempco Industrial, Inc., Machine & Tool Division, Bedford, Ohio. Folder describing seventeen new presses and press brakes, ranging from small shop models to large 1000-ton capacity presses. Many applications: die tryout, molding, gap frame, etc.

Circle Item 546 on Inquiry Card



Microptic Auto-Collimator

Engis Equipment Co., Chicago, Ill. Folder giving information on a strip film and disc recording explaining the principles and applications of the microptic auto-collimator. It is available for loan. The film shows many applications for machine tools.

Circle Item 541 on Inquiry Card



Stainless-Steel Filters

Micro Metallic Division, Pall Corporation, Glen Cove, N. Y. Bulletin on multiple-surface, porous stainless-steel filters, including information on porous stainless-steel filters which can meet a wide range of flow rates, temperatures, pressures, and slurries.

Circle Item 547 on Inquiry Card



... HIGH DUCTILITY AND LOW COST WHEN DIE CAST WITH... ZAMAK





SEND FOR YOUR COPY TODAY

"THE END USES OF ZINC DIE CASTING" Strength of this light-weight zinc die cast hand wheel is achieved by rigid, thin-wall sections. Cast in one piece with a U-section rim, the excellent ductility of ZAMAK allows forming at room temperature with one stroke of a high-speed press.

This low-cost roll-forming procedure, possible only with zinc die casting alloys, accounts for its wide use on many types of partshandles, knobs, couplings, locks, etc.

And the smooth, as-cast ZAMAK surface, of course, allows lowcost plating or painting for almost any type of product.

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

THE NEW JERSEY ZINC COMPA

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY 160 Front Street . New York 38, N. Y.



catalogues bulletins manuals

• Yours for the asking. . . . Use postcard inside back cover



Automatic Shear

Clearing Division, U. S. Industries Inc., Chicago, Ill. Folder giving operational instructions for a medium-size scrap shear. It is completely wired for "plug-in" installation and has automatic controls and a self-contained hydraulic system.

Circle Item 548 on Inquiry Card



Work-Holding Machine

Hammond Machinery Builders, Inc., Kalamazoo, Mich. Bulletin 421, presenting a cammed junior automatic work-holding machine (Model EPC), designed to hold other than round work-pieces while being buffed by a regular polishing and buffing lathe.

Circle Item 554 on Inquiry Card



"Antiskid" Compound

Carborundum Co., Niagara Falls, N. Y. Folder on Carbo-Latex P5, a new synthetic latex abrasive compound for safety antiskid floors, highways, and airstrips, with excellent affinity to concrete, asphalt, sealed wood, and other traffic surfaces.

Circle Item 549 on Inquiry Card



Flame-Spray Process

Metallizing Engineering Co., Inc., Westbury, L. I., N. Y. Bulletin 136B-30M, providing engineering data on coatings of metals, ceramics, carbides, and other high-melting-point materials, as well as the metallizing process which sprays powdered metals.

Circle Item 555 on Inquiry Card



Hydraulic Shears

Verson Allsteel Press Co., Chicago, Ill. Catalogue No. VHS-59 featuring a line of hydraulic shears with different capacities. Specifications are given. The latter include double-acting cylinders and pistons, gages with shut-off valves for pressure checking the main, etc.

Circle Item 550 on Inquiry Card



Air Tools

Master Power Corporation, Bedford, Ohio. Catalogue entitled "Metal Finishing with Master Power Air Tools." The company's complete line of grinders, sanders, and wire brushing tools is described and illustrated. Specifications are given.

Circle Item 556 on Inquiry Card



Motor Bases

Browning Mfg. Co., Maysville, Ky. Catalogue SL-101-A, describing a line of spring-loaded and manually controlled type variable-pitch sheaves and adjustable motor bases, which can be adapted to nearly any machine using a single V-belt.

Circle Item 551 on Inquiry Card



Structural Adhesives

Minnesota Mining & Mfg. Co., St. Paul, Minn. Catalogue on Scotch-Weld Brand structural adhesive design concepts and bonding methods. Write on company letterhead to E. F. Hess, Adhesives, Coatings & Sealers Division, Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.



Broaches

California Broach Co., Los Angeles, Calif. Brochure describing standard off-the-shelf round, square, hexagon, and serration portable push type broaches. Included are complete specifications and operating instructions for applying the "SIR PRESQUICK" broaches.

Circle Item 552 on Inquiry Card



Dellis

Pratt & Whitney Co., Inc., West Hartford, Conn. Brochure presenting a line of deep-hole drills for long, accurate, "super-finished" holes in any kind of material—from soft metals to Space Age alloys. Specifications and illustrations are provided.

Circle Item 557 on Inquiry Card



Contract Forming

Cyril Bath Co., Solon, Ohio. Catalogue describing three high-speed forming machines. Many of the techniques and advantages in radial draw, stretch, and compression forming are utilized in the new machines. Actual parts produced are illustrated.

Circle Item 553 on Inquiry Card



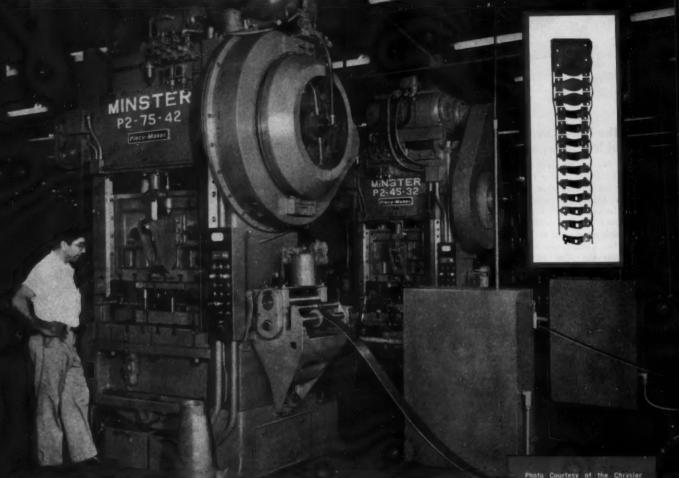
Solenoid-Operated Cylinder

The Sheffer Corporation, Cincinnati, Ohio. Bulletin No. 458, on a light-weight, extra-compact, solenoid-operated 1 1/8-inch bore cylinder for air, oil, or water operation, ideal for tooling and automation, known as Sheffer "Valv-N-Hed (R)" series.

Circle Item 558 on Inquiry Card

Lower your per unit stamping cost with

AUTOMATIC PRODUCTION



Minster Piece-Maker® Presses

You get more parts per hour at a lower unit cost when you produce stampings automatically. Costs shrink as you eliminate expensive rehandling and storage of parts between operations.

Minster offers a complete range of press types and sizes for all kinds of profitable automatic production . . . long runs, short runs, big parts or tiny parts.

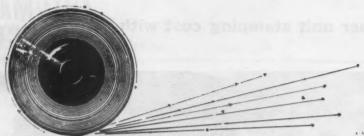
The right Minster press, with feed equipment matched to both press and job, can lower your unit costs, give you maximum productivity. Want more facts? Write or call us today.

The Minster Machine Company . Minster, Ohio

MINSTER

Photo Courtesy of the Chrysler Corporation, Indianapolis, Indiana,

Minster Piece-Maker automatic production presses are designed for rigidity and built with precision. From 20 to 300 ton capacity.



E. S. Salichs

BETWEEN GRINDS

The Triple Olympic Deal of Ice, Snow, and Steel

From Steelways, we learned that the 1960 Winter Olympic Games at Squaw Valley in the Sierra Range of California benefited greatly from the use of steel. Figure skaters glided over the first artificially refrigerated rink ever used in Olympic competition (nearly 11 miles of steel pipe carrying the refrigerating brine); skiers rode to their launching platform on chairs hung on wire rope strung over thirteen steel towers; and 8000 spectators were seated in a unique steel-reinforced structure under a 300-foot clear-span roof.

Metal on Its Mettle

The Navy, we read in *Industrial Research Newsletter*, is doing research on the sparking characteristics, not of its men as you might suppose, but of tool metals. Those

metals identified as safe to use in tools or other devices in explosive atmospheres are manganese bronze, phosphorous bronze, aluminum bronze, commercial brass, aluminum, and beryllium copper.

Scatter, Here Comes Skeeter

'Skeeter," a power scooter, was developed by an Illinois Institute of Technology student, Louis R. Richards, who evidently became impatient covering the campus on foot. He used a 1/32-hp model aircraft engine mounted on the front end of an 18-inch-long platform riding on figure roller-skate trucks. The vehicle weighs only 12 pounds, and when collapsed in a canvas carrying case, measures 6 3/4 by 9 1/2 by 29 inches. Skeeter, which may be massproduced for about \$50, should interest one-car commuters as well as collegians.

Help for Heels

Women's reedlike spike heels frequently snapped like matchsticks under the strain of impact against floors (according to News and Progress in Metals, which tactfully omitted the factor of weight). But now a lightweight aluminum alloy of exceptional strength forms the inner shaft that takes the real punishment, thus relieving the harassed shoe manufacturers. And the ladies

Hair to Stay

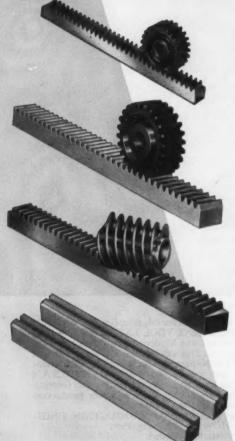
We were reading about the president of an insurance company who got all his bald-headed salesmen together and persuaded them to get fitted with hairpieces, thus making them more appealing to worken customers. The salesmen bowed their heads (either in embarrassment or agreement), wore their toupees, and sales jumped 40 per cent. Still prefer to sell machinery?

TOOL TOUR—"The Story of the Cutting Edge," an educational exhibit sponsored by the DoALL Co., is being transported around the country by special truck. The exhibit consists of three features—a 43-foot-long panel which displays the chronological development of cutting edges from stone, to bronze, to steel, to carbides and ceramics; a lecture-slide presentation of modern machining techniques; and a display of all kinds of cutting tools and parts. In its second successful year on the road, and only the tools edgy.



GEAR RACKS





any type, any size, any material

with quality as a first consideration

Throughout industry, manufacturers depend on ILLINOIS GEAR to meet their exacting specifications for quality gear racks . . . from the large powerful, heavy pitch racks for steel mill equipment to the precision spur or helical racks for machine tools.

And there's good reason; these manufacturers expect and get the dependability and superiority proven by the performance of these racks throughout the world.

Whatever your requirements are for changing rotary power to linear power depend on ILLINOIS GEAR for racks that are made right with quality as the first consideration.

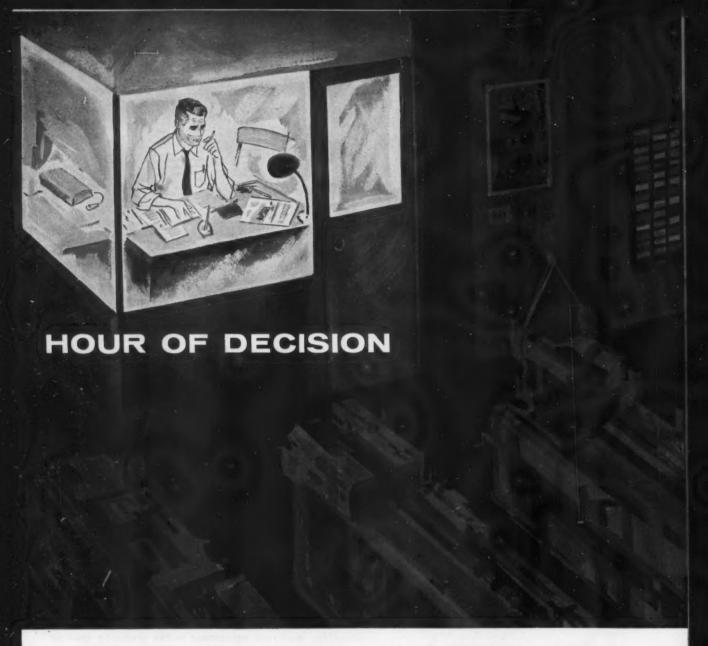
Look for this mark . . . the symbol on finer gears



Gears for Every Turpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

2108 NORTH NATCHEZ AVENUE . CHICAGO 35. ILL



After hours? — sure You're not surprised at that because you know it's when he (and probably you, too) concentrates on the problems which are vital to his company's continued successful growth. The day is filled with production crises, maintenance problems, personnel questions, and committee meetings. It's only now that he can really study the facts and decide what's best.

Right now he's reviewing his machine tool inventory. He's amazed at how old some of his equipment is getting to be. It seems only yesterday that he signed the purchase order for it to increase his capacity for World War II. But that was 1943, seventeen years ago! No wonder maintenance is getting high and efficiency is dropping off.

We've got a suggestion for this man (and for you, too). Attend THE MACHINE TOOL EXPOSITION — 1960 and see for yourself why Modern Machine Tools = Production Efficiency. This exhibit, the first since 1955, is sponsored by The National Machine Tool Builders' Association* and will contain eleven acres of the U.S.A.'s, newest machine tools under power, cutting and forming metal to demonstrate 1001 ways to lower production costs. Can you afford to stay home?

You're also invited to the PRODUCTION ENGINEERING SHOW on the Navy Pier.

No extra registration needed.

*The N.M.T.B.A. represents 90% of the U.S.A. machine tool industry.

FORMULA FOR TOMORROW



International
Amphitheatre
Chicago, Illinois
Sept. 6-16

THE MACHINE TOOL EXPOSITION - 1960

NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

2139 Wisconsin Avenue, N.W. . Washington, D. C.

SND-A NEW NATURAL DIAMOND GRIT FOR HIGHER GRINDING EFFICIENCY

Announcing

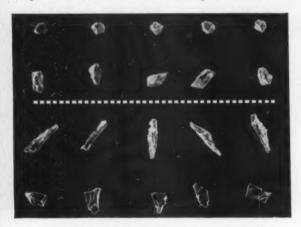
The development of a New diamond grinding material— SND (Selected Natural Diamonds) and

SND — a new natural diamond

SND—THE LATEST TECHNICAL DEVELOPMENT FOR IMPROVING CARBIDE GRINDING PERFORMANCE

SND (Selected Natural Diamonds) is a *New* natural diamond abrasive developed especially for resinoid bond grinding wheels. It is made up of needle shaped grains and thin, flat platelets selected from diamond boart that has been crushed by a special method.

Diamond particles at least twice as long as they are wide are classified as "needles," and particles that are less than one-quarter as thick as they are wide are classified as "platelets."



Top: Blocky diamond particles predominating in conventional grit.

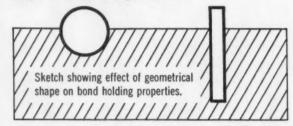
Bottom: Needle and platelet diamond particles predominating in new SND Selected Natural Diamond grit.

Conventional natural diamond grit sludge

The absence of large particles in SND—Selected Natural Diamonds sludge shows why SND gives up to 30% longer wheel life and increased wheel efficiency over conventional diamonds.

SND-Selected Natural Diamond grit sludge

Why "needles and platelets"?

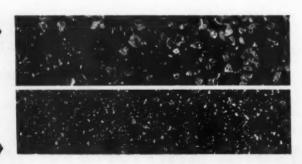


For many years, blocky shaped diamond particles were considered ideal for any type bond grinding wheel. Recent laboratory research into the influence of particle shape on grinding efficiency proved that blocky particles were *not* as efficient in resinoid bond wheels as were thin, flat and needle shapes.

Subsequent tests bore out the important facts that, blocky shapes either wore down level with the matrix, or were pulled out of the bond; while needles and flats seldom pulled out, and instead of wearing smooth, tiny bits broke off in a manner which constantly exposed new, sharp cutting diamond edges to the work.

Tests verified by sludge analysis

Analysis of the sludge and swarf collected after tests of both SND and conventional grit wheels verified the test findings. Only uniformly tiny diamond particles were found in residue from SND wheels, proving that each SND particle was almost wholly utilized in the grinding process.



grit for higher grinding efficiency!

How SND (Selected Natural Diamonds) increases grinding efficiency

SND provides more sharp cutting edges per carat in the same grit size.

More cutting edges means a faster, cooler cutting wheel that will last up to one-third longer than resinoid wheels made with conventional grit.

The thin needle and flat grains in SND possess the right amount of natural strength, yet break down easily for fast, free, and continuous cutting.

SND grit offers maximum holding surfaces to the bond, reducing non-productive pull-outs.

SND sharper cutting edges reduce wheel loading and glazing.

Proved in laboratory runs . . .

Extensive laboratory runs show SND grit is up to 30% more efficient than conventional grit when grinding cemented carbide at .0005" to .0015" in-feeds and speeds of 5500 S.F.M.

Proved in the field

Many metalworking plants now are proving the new SND grit in their own shops with results that substantiate the already-completed laboratory evaluations.

TREATED SND—ANOTHER NEW GRIT DEVELOPMENT!

A process for treating SND (Selected Natural Diamonds) grit to make it even more friable and to give it superior bonding properties in resinoid wheels also has been developed. This process introduces surface irregularities in the otherwise smooth planes of the SND

particles; these tiny cracks and crevices promote faster breakdown after wear and stronger bonding. Already proved to be more efficient than conventional grit at feeds of .0005" to .0015", on carbide, Treated SND is recommended only for lighter feeds, and where the nature of the work demands rapid grit particle breakdown.

The selection is yours . . .

SND grit-for tough applications.

SND Treated grit—for light feeds and coolest cutting.

Conventional grit—for heavy feeds (.003" and up) and the recommended material for metal or vitrified bond wheels,

Available now

Your diamond wheel supplier can now furnish you with grinding wheels made with the new SND grit—either treated or untreated—ask him about SND today!

Diamond experience

Ready to discuss your diamond problems are Industrial Diamond Division Field Engineers located in key metal-working centers. These are technical men with natural diamond backgrounds and experience. Field offices are in Boston, Chicago, Cleveland, Detroit, Los Angeles, Newark, New York and Philadelphia.

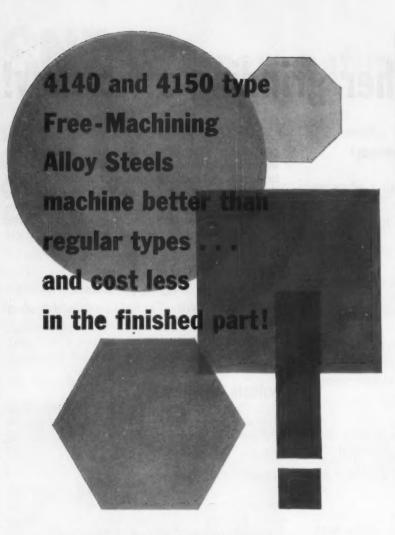
Technical information service

A new and complete technical information service to help keep you abreast of the latest developments in industrial diamond technology has been established. Monthly Diamond Data and Technical Bulletins will be sent you without obligation. Simply send us your name, title and company address.

ENGELHARD HANOVIA, INC.

INDUSTRIAL DIAMOND DIVISION

113 ASTOR STREET . NEWARK 2, N.J.



Wheelock, Lovejoy is your best source of 4140 and 4150 type free-machining alloy steels, the easyworking steels that machine far better than regular type steels, and which cost *less* in the finished part.

Wheelock, Lovejoy, for many years the pioneer in the development and application of 4140 and 4150 type free-machining alloy steels, offers you the most extensive stocks anywhere, in all W-L warehouses.

Available variety of 4140/50 type free-machining stock includes round, square, flat, billets, and forgings to specifications.

For best stocks, best service, get in touch with your nearest Wheelock, Lovejoy warehouse.

W.L STEEL SERVICE CENTERS — Cambridge • Cleveland Chicago • Hillside, N. J. • Detroit • Buffalo • Cincinnati AGENTS—Southern Engineering Company, Charlotte, N.C.; Sanderson-Newbould, Ltd., Montreal and Toronto

"The Alloy Steel Center"

WHEELOCK,
LOVEJOY
& COMPANY, INC.
138 Sidney Street, Cambridge 39, Mass.

138 Sidney Street, Cambridge 39, Mass.

(Continued from page 186)

"Ceramax" Rotary Chuck

A rotary, permanent ceramicmagnetic chuck called the "Ceramax" was introduced at the show by the O. S. Walker Co., Inc.,



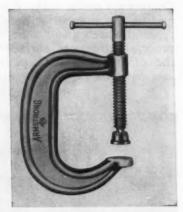
Walker Ceramax chuck

Worcester, Mass. This chuck is so powerful magnetically that it can be used safely for lathe work as well as for grinding. A special "lock" safety feature is said to insure positive magnetic holding under the most rapid start and stop conditions. Variable holding power is provided to facilitate work positioning. The chuck also features an all-steel top plate. No electrical accessories are necessary.

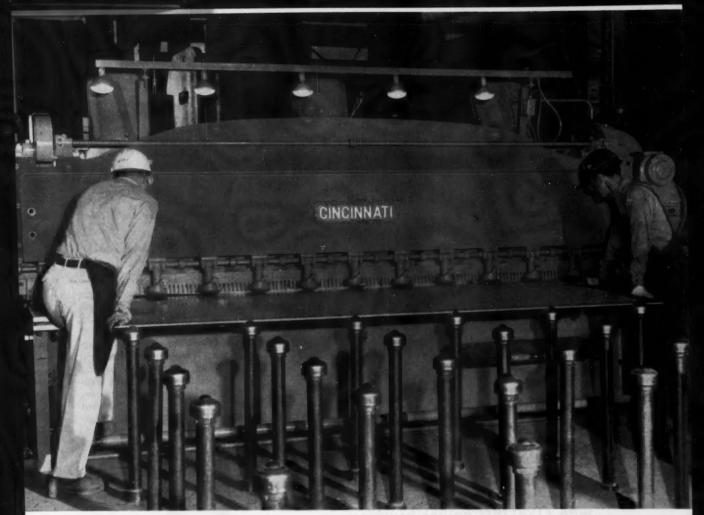
Circle 593 on Readers' Service Card

Improved C-Clamp

The Armstrong Bros. Tool Co., Chicago, Ill., has announced their deep-throat, drop-forged "C" clamps equipped with a new style swivel pad which cannot be knocked off the clamp, even under the most severe working conditions. This pad is attached to the



Armstrong improved C-clamp



Courtesy Bannock Steel Company

Maintenance negligible

ON 6 YEAR OLD CINCINNATI® SHEAR

"We have had this Cincinnati Shear in almost constant operation for something over six years," says S. L. Cate of Bannock Steel Company, Pocatello, Idaho, "and, to date, maintenance costs have been almost negligible. We certainly feel this is truly a remarkable performance."

Bannock Steel Company recently installed a new Cincinnati Hydraulic Press Brake—clear evidence of their confidence in the Cincinnati line. See our insert in Sweet's Machine Tool file.

THE CINCINNATI SHAPER ...

Shapers / Shears / Press Brakes Cincinnati 11, Ohio, U.S.A.



In Scotland: The Cincinnati Shaper Co., Ltd., Glasgow



BEFORE BRUSHING

Insulation residue on this small, copper elec-tric motor commutator was a knotty, costly cleaning problem. Rate: 800 per hour.



Surface quality-finished . . insulating material and feather burrs gone . . . ready for trouble-free assembly. Rate: 3500 per hour.



Production soars from 800 to 3500 pieces per hour

...with OSBORN power brushing



PRODUCING at the rate of 3500 pieces per hour (over 330% greater than former off-hand method) these Osborn TY. Master Wheels remove troublesome phenolic-type residue from electric motor commutators at Dayton Precision Manufacturing Co.

Slow, off-hand methods were being used to remove insulation residue from these commutators. Production was costly . . . parts lacked uniformity.

A specialized, but simple machine now handles the operation. Parts are automatically fed along a guide tube and through a pair of Osborn TY. Master. Wheel brushes. In this centerless type finishing setup-the job is done effectively in pre-set time cycles. Results: production and quality up-rejects eliminated . . . time and costs down.

Cleaning and finishing problems in your plant can be solved with similar production savings. An Osborn Brushing Analysis-made in your plant now at no cost or obligation-is the first step. Write us for full details. The Osborn Manufacturing Company, Dept. D-58. Cleveland 14, Ohio.

Sborn Brushes

METAL FINISHING MACHINES . . . AND FINISHING METHODS POWER, PAINT AND MAINTENANCE BRUSHES . FOUNDRY PRODUCTION MACHINERY screw by forcing the recessed lip of the pad opening down, thereby forming a solid steel wall which encircles the ball of the screw. The wall prevents the pad from coming off in normal use, but allows it to swivel approximately 40 degrees. "400-Series" deep-throat These clamps are available in capacities of 0 to 1 1/2 inches through 4 to 12 inches.

Circle 594 on Readers' Service Card

Schmidt Marking Tool

Among the marking machines exhibited at the recent show by George T. Schmidt, Inc., Chicago, Ill., was their new GTS "Pneumark" impact bench press, Model 10T. This press was set up with hopper feed for marking hexagonal nuts. It is specifically designed for efficient identification marking of steel parts or nameplates. Features include: low initial cost; compact bench size; fast setup without down time for further adjustment;



Model 10T Schmidt marking machine

safe, fully automatic operation; and production rates of from 3000 to 3600 pieces per hour. Stamp character sizes range from 1/16 to

Uniform marking is obtained on parts which have slight thickness variations without changing the pressure setting. Full 10-ton max-

NEW K165...

It's different than any other KENNAMETAL CUTTING GRADE

TYPICAL PERFORMANCE OF KENNAMETAL K165

Work Material	Operation	Tool	Depth of Cut	Speed sfm	Feed ipr	Performance
Arma Steel 88M, 32 RC	Finish facing 50 rms max. finish	KSBL-16C SPG-422	.021"	775	.0024	77 pieces per index with 20-30 rms finish. Best performance other tool material: 20 pieces per index with 40-60 rms finish.
AISI 308 Stainless Steel Tubing	Finish turn tracer lathe	KTGR-20C with TPG-433	.020" to .093"	950	.010	Negligible tool wear. 50 rms finish0001" loss of size in 41" cut. Old tool material: .030" flank wear, unacceptable finish, and .005" loss of size.
Cast Iron	Finish turning	Special TNG-321	.020"	1260	.009	Best performance of any other cutting materials evaluated.
M2 HSS Forging	Finish turning	KSFR-16 SNG-422	.100*	585	.016	11 pieces produced with less than .005" wear land. Previous tool material: 6 pieces at considerably lower machining conditions.
304 Stainless Steel	Precision boring	Precision boring tools	.0075"	1500	.003	6 holes, 5" deep, resulted in only .0002" loss of size and a surface finish of 10 rms.
Tricent Cylinder Case, 44.3" dia. x 23" long, 46 RC	Finish turn	KTDR-16C TPG-322	.005"	480	.007	40-60 rms finish. No measurable taper or tool wear. Previous tool material: extreme difficulty in obtaining 125 rms finish; unacceptable taper required additional passes and severe steps.

Engineered for the new era in machining

- For high velocity precision machining.
- Exceptional high hardness-strength for machining high temperature alloys of low machinability.
- Possesses greater combined crater and edgewear resistance than conventional tungsten carbide cutting tool materials.
- Produces surface finishes as low as 12 rms and better . . . frequently eliminates expensive grinding operations.
- Maintains greater accuracy . . . reduces "loss of size" due to greater resistance to edge wear.

now available in limited number of KENDEX* INSERTS

KENNAMETAL Inc

LATROBE, PENNSYLVANIA

07207

MARVE SYNCLINAL FILTERS

FOR DEPENDABLE PROTECTION on all Hydraulic and other low pressure circulating systems

Designed to give more ACTIVE filtering area—MORE dependable protection—MORE productive operation before cleaning is necessary. Meet J.I.C. Standards.



Synclinal SUMP TYPE

CAPACITIES: 5-8-10-20-30-50-75 and 100 G.P.M.

PIPE SIZES: 12-12-14-14-14-21-24 and 3. CONNECTIONS: Coupling-Male Nipple. BY-PASS VALVE: Not Available.



Synclinal LINE TYPE

CAPACITIES: 5-8-10-20-30-50-75 and 100 G.P.M.

PIPE SIZES: %"-1"-1%"-1%"-2"-2%" and 3". BY-PASS VALVE: Not available. OPERATING PRESSURES: Up to 80 p.s.i.



Bonded SUMP TYPE

CAPACITIES: 10-20-30-50 and 75 G.P.M. PIPE SIZES: 1"-11/4"-11/4"-2"-and 21/4". CONNECTIONS: Coupling-"O" Ring-Male Nipple. BY-PASS VALVE: Available with or without



Bonded LINE TYPE

CAPACITIES: 10-20-30-50 and 75 G.P.M. PIPE SIZES: 1"-11/4"-11/4"-2" and 21/4". BY-PASS VALVE: Available with or without. OPERATING PRESSURE: Up to 250 p.s.l. **OPERATING TEMPERATURES** up to 300° F.



Tandem SUMP TYPE

CAPACITIES: 10-16-20-40-60-100-150 and 200 G.P.M.

PIPE SIZES: 1/4"-1"-11/4"-11/4"-2"-21/4" and 3". CONNECTIONS: Coupling-Male Nipple. BY-PASS VALVE: Not available.



IN-LINE FILTER

CAPACITIES: Up to 60 G.P.M. PIPE SIZES: $\frac{3}{4}$ –1"–1 $\frac{1}{4}$ " and 1 $\frac{1}{2}$ " (at both inlet and outlet).

BY-PASS VALVE: Available with or without

FILTERING MEDIA in all Marvel Filters is Monel wire cloth available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your filtration requirement. EASY TO CLEAN-All Marvel Filters are easy to clean. Line type units operate in any position and may be serviced without disturbing pipe connections. OVER 900 O. E. M's. install Marvel Filters as Standard Equipment.

IMMEDIATE For further information on a specific type filter-DELIVERY Write-wire or phone

MARVEL ENGINEERING COMPANY 7227 N. Hamlin Ave., Chicago 45, III. Phone: JUniper 8-6023



Please send me information	n on Marvel Filters as indica	ited:	MY
☐ Hydraulic Oils ☐ Water	□ Coolants □ Sump Type	☐ Lubricants ☐ Line Type	☐ Fire Resistant Fluids ☐ In-Line
Name			
Company			
Address			
City		State	

imum stamping capacity is available. Air-line requirements range from 20 to 100 pounds psi. This machine can be equipped with dial feed having automatic cycling and intermittent movement or a stacker type feed. The steel base is drilled and tapped to facilitate setting up a variety of fixtures or nests. Die space can be quickly adjusted up to a maximum of 11 inches by means of a single rackand-pinion adjustment.

Circle 595 on Readers' Service Card



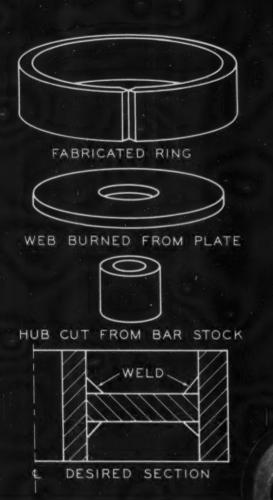
McCrosky positive-angle cutter

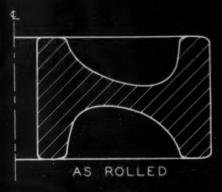
Milling Cutters with **Throw-Away Inserts**

The McCrosky Tool Corporation, Meadville, Pa., displayed at the recent tool show: "Jack-Lock" milling cutters; Series "900" cutters for milling with throw-away carbide inserts; thin slotting cutters; "Super" adjustable reamers; turret toolposts; "Wizard" quick-change chucks; boring-bars; and specially engineered, multipleoperation tools that permit two or more related operations to be performed in one set up.

In addition, the company introduced, for the first time, a new line of positive-angle cutters for milling with throw-away carbide inserts. The development of these cutters with positive cutting angles is reported to make milling with throw-away inserts applicable to machines with limited horsepower; jobs having thin sections not suited for milling with negative-angle cutters; and for milling soft or stringy materials, or when a high finish is desired. The cutters are available in face-mill, shell-end and half-side mill designs.

Circle 596 on Readers' Service Card (This section continued on page 210)







Why fabricate it?

(and pay for waste metal, assembly time, welding?)

Bethlehem Circular Forgings come ready for finish machining. Unlike a weldment, there's no fabricating to be done. No assembling. No welding. You save the high cost of all those operations—and the cost of the metal those operations waste.

Cost? Thanks to our Slick Mill (the only one of its kind in the country), the cost of Bethlehem Circular Forgings is low. Even if new tooling is required, orders of 20 or more pieces are economical (dies can be changed in just 15 minutes). Our mill forges and rolls an impression-die forging in about one minute. Because contact time between die and

We'll forge it!

(and cut your costs: less metal, no assembly or welding)

work is so brief, and because there's no impacting, low-cost dies can be used.

There you have it. One, important fabrication savings. Two, low initial price. That's why forged circular products consistently cost less than weldments.

Bethlehem Circular Forgings are available in carbon, alloy, or stainless steels, and some heat-resistant grades. 10 to 48-in. OD. 100 to 2,000 lb. As-rolled or rough-machined to specifications. For full details, call or write the Bethlehem sales office nearest you.

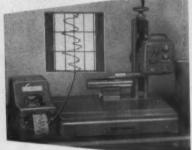
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL



only the TALYSURF

truly records surface finish 1 to 2000 microinches



The Talysurf is the final authority for surface measurement—a true inkless straight line graph of every irregularity on all finishes—mirror smooth to rough machined.

The .0001" diameter stylus faithfully traces all scratches under a pressure of only 0.1 gram (.0035 ounces). Also provided is the integrating average meter which gives in a single stylus traverse the correct average reading—there is no wavering of the pointer.

For parts that require unquestioned surface accuracy, a check with the Talysurf eliminates time-wasting, costly arguments. The Talysurf is your guarantee of reject-free production, whatever the surface finish specification.

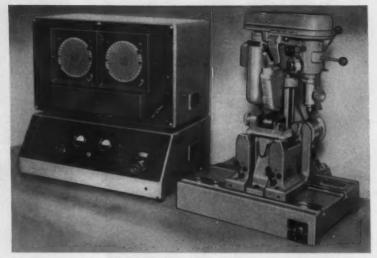
with universal accessories, the Talysurf provides surface analyses on all materials, hard or soft—and shapes, flat or curved. Your surface analysis problem is invited for study.

ENGIS

EQUIPMENT COMPANY
DIVISION OF ENGINEERING AND
SCIENTIFIC INSTRUMENTATION

431 SOUTH DEARBORN ST. CHICAGO 5, ILL.

Circle this page number on card



Schenck dynamic balancer introduced by the Cosa Corporation

Balancers Designed for Small Parts

Two Schenck balancers are now available through the Cosa Corporation, New York City. These models, known as R06 and R16. are ultra-precise, high-speed balancing machines designed for miniature parts such as gyroscope rotors and assemblies, fractional motors, turbo-chargers, etc. Both models are bench type units, specifically designed to accept, with little or no tooling, work-pieces which may be belt-, air-, or electrically driven, or self-powered. The rotor weight ranges are either 0.03 pound to 6 pounds (R06), or 0.1 pound to 20 pounds (R16). Rotating speeds may be anywhere from 1500 to 30,000 rpm.

The balancer is so sensitive that unbalances creating work-support movements as small as one-half millionth of an inch are clearly indicated. An ultra-precise Wattmeter system indicates out-of-balance conditions simultaneously in two planes. On two calibrated circular screens, light spots move from the screen centers in proportion to the amount of unbalances. The direction of movement indicates the angular location of unbalances. The light spots may be locked in place as a double-check reference during correction. No tuning or adjustment is necessary during the balancing procedure. The electrical network has built-in plane separation to avoid crossinterference between the two planes. It also incorporates an independent calibrating device for

each side, to establish relationship between the amount of unbalance in the work-piece and the lightspot deflection on the screens (that is, 0.0001 ounce-inch per unit or 0.001 inch drill depth per unit).

Synchronization between unbalances shown on the Wattmeter screens and location of unbalances in the work-piece is established by a photoelectric pick-up. Impulses, generated independently of unbalance magnitude, also serve to measure revolutions per minute of the work-piece.

Correcting unbalance conditions may be done with the work-piece removed from the rotor supports or with the work-piece left in place. The Schenck balancer shown has a built-on drill press for this purpose. Downward pressure on the work-piece by the drill press is nullified by a supporting arm which rises from below the work-piece. This prevents damage to thin rotor shafts and delicate bearings.

For electrically driven work-pieces, the balancing cycle can be made automatic. After loading the work-piece in the rotor supports, one button starts a cycle which brings the work-piece to the preselected revolutions per minute, shows and freezes unbalance readings, and then stops the rotor. Cycle time for this operation is about five to fifteen seconds, depending on rotor weight and speed of rotation.

Circle 597 on Readers' Service Card (This section continued on page 212)



REED Instrument Bearing



Angular Contact Bearin



Spherical Roller Thrust Bearing



Tapered oller Bear



Spherical



What's a "special size" in production bearings?

makes so many standard sizes, there's practically no such thing as a "special size" of bearing. They range from tiny instrument bearings right up to four-row tapered roller bearings—and account for almost every possible bore size in-between.

Take &SSF's standard cylindrical roller bearing, for example. It's promptly available in 154 sizes of single- and double-row types -for shaft diameters ranging from 1" to 9.5". Every size, in both types, offers high radial capacity in relation to its size and operates at highest speeds because of its very low friction.

So, before you specify a "special size" bearing, call the nearest \$\mathbb{B} \mathbb{S} \mathbb{F}\$ sales office first. The odds are better than 1,000 to 1 that there's already a standard \$\mathbb{B} \mathbb{S} \mathbb{F}\$ bearing of exactly the size you need.









SKP.

ONLY

is the originator and developer of the revolutionary new L-100-M

SPEED-BAND®

double carbide Band Saws



ONLY

available from authorized CAPEWELL Distributors





THE CAPEWELL MFG. CO.

HARTFORD 2, CONN.

Circle this page number on card



Starbore reamers for drilled or cored holes

Star Cutter Pressure-Coolant Carbide Reamers

A multiple-flute "Starbore" pressure-coolant carbide reamer has been introduced by Star Cutter Co., Farmington, Mich. This tool operates satisfactorily in either drilled or cored holes and reams long holes with precision. It consists of a molded solid-carbide tip brazed to a tubular steel shank. Pressurized coolant is directed through the shank of the tool into

angular holes at the ends of each of the flutes in the tip, forcing the chips ahead to avoid wedging between the surface of the hole and the tool's cutting edges. The reamer operates in conjunction with a guide bushing. Both straight or spiral flute designs are available. The tools are now made in sizes up to 4 inches in diameter.

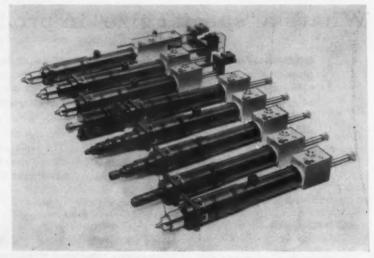
Circle 598 on Readers' Service Card

Buckeye Automation Drilling, Tapping, and Grinding Tools

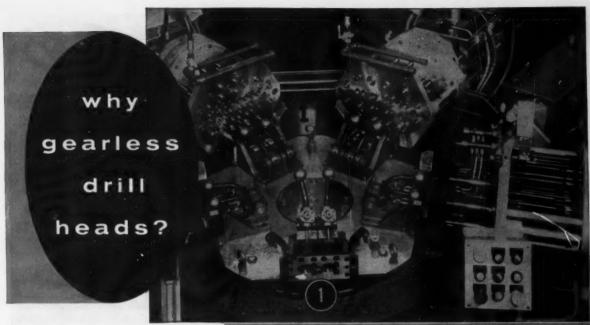
A series of automation tools, designed to combine the efficiency and economy of air-motors and air cylinders, has been introduced by the Buckeye Tools Corporation, Dayton, Ohio, for use in drilling, tapping, fastening, grinding, reaming, counterboring, and wire brushing. Unlike most Buckeye tools which produce rotary motion only, these 21K and 21L series tools also provide linear motion, moving from their fixed

retracted positions to precise work spots. The length of the stroke can be adjusted to micrometer accuracy over the 0- to 2-inch range by rotating the graduated external sleeve, then locking it in place. The tools may be operated singly or in groups in any desired sequence using controls designed to give the required degree of automation.

The two series differ only in the construction of the feed cylinder.



Automation tools introduced by Buckeye Tools Corporation



because

Zagar

design uses more spindles in smaller space with minimum tooling and requires short change-over time

Four fixture assemblies, mountable on a common index table, have five stations each for drilling, reaming, and tapping left- and right-hand cylinders at 400 pieces per hour. In all, 2800 holes are produced.



Zagar gearless design permits flexibilities in building machinery with results not obtainable elsewhere. By using many spindles and tooling more parts in one machine, fewer units, less space, and little change-over time are required.

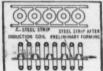
Gearless design allows close center hole production without changing spindle locations in heads. Varying hole patterns can be obtained without additional heads. Interchangeable fixtures on the same index table, therefore, compound the potential hole production—in one basic unit.

Find out how Zagar can program your entire drilling, reaming, and tapping job by sending us a part for an engineering study.

Ask for Manual M-5 for basic Zagar theory.

INCORPORATED
23888 Lakeland Blvd. • Cleveland 23, Ohlo
USE MORE SPINDLES TO DO MORE WORK





Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

WRITE FOR NEW LEPEL CATALOG ectronic Tube Generalors from 1 Kw to 100 Km Spark Gap Converters from 2 Kw to 30 Kw

Lepel HIGH FREQUENCY

55th ST. & 37th AVE., WOODSIDE 77, N.Y.

Circle this page number on card

The 21K series is retracted by a spring return system, while the 21L is retracted by a double-acting air cylinder to preserve higher feed and/or retraction forces. Both series are available with standard heads that employ an integrated needle valve to control feed rate without affecting spindle speed. A complete stroke-control package can be supplied.

Air-motors are well adapted to automation use, since they can be run to the point of stall without damage. The Buckeye motors of this series have a speed range of from 650 to 22,000 rpm. These tools weigh from 4 3/8 to 6 pounds. Lengths range from 16 3/4 to 23 3/16 inches.

Circle 599 on Readers' Service Card

Two-Position Slide Table Powered by Air or Hydraulic Cylinder

An air- or hydraulic-operated table that provides working and loading-unloading stations or two work positions on the same part, and which permits consecutive operations with stroke lengths infinitely adjustable from 1 to 15 inches, has been announced by Russell T. Gilman, Inc., Grafton, Wis. The slide movement is powered by a 3-inch-bore air cylinder or a 2-inch-bore hydraulic cylinder. Stroke length is infinitely adjustable from 1 to 15 inches by means of the new Gilman system of hydraulic cushions and stops. Almost any type of slide cycle control can be obtained with the optional valve and electrical combinations which are available. The working surface of the top slide member measures 30 by 12 inches and is provided with two longitudinal 5/8-inch bolt T-slots, spaced 6 inches apart.

Circle 600 on Readers' Service Card



Engis adjustable-tilt swivel vise

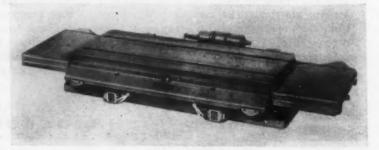
Adjustable-Tilt Swivel Vise, "Di-Profiler," and Hones

The Hyprez Division of Engis Equipment Co., Chicago, Ill., exhibited a variety of new products at the recent tool show. One of these is an Engis tilting swivel vise which swivels through 360 degrees of arc and tilts 30 degrees up or down in any position. This vise is available in two sizes.

The Engis motor Model "E," for the "Di-Profiler" reciprocating hand machine, is equipped with an integrated gear-box which permits the use of very low speeds without the loss of power.

A new Di-Profiler standard set No. 1, which included the Engis Di-Profiler with Motor Model "E" previously described, and a comprehensive assortment of reciprocating and rotary accessories were also displayed. In addition to this equipment, the Hyprez exhibit included diamond compounds and accessories; the Di-Profiler reciprocating hand machine with diamond points and wheels, mounted laps and hones, diamond and Swiss style steel files, and other accessories; and the Hyprez oscillating-tool finishing machine.

Circle 601 on Readers' Service Card (This section continued on page 216)



Gilman two-position slide table

CREATIVE COST CUTTING

Selecting the metal to fit the job can give you surprising savings in total cost





Small spring clips between telescoping parts of auto radio antennas must maintain electrical contact, hold parts firmly, give smooth sliding action. Brach Manufacturing Division of General Bronze Corp., Newark, N. J., found that spring clips of Duraflex®, Anaconda superfine-grain phosphor bronze, gave best positive electrical contact and improved smooth action in Brach Auto Antennas over original clips made of premium metals. The clips stand up in constant use, spot welding and fabrication are easier—and costs are about 25% lower.





In this G-E Automatic Coffee Maker control, a thermostat turns cam actuating switches—for high heat to brew coffee, for low heat to keep it warm. At first, upper switch element was an assembly of blade, bushing, and locking nut. Tinnerman Products Inc., Cleveland, Ohio, engineered a one-piece Speed Clip to replace it—by forming one thread in the blade and two prongs to lock the screw (see inset above). This simplification called for a superior phosphor bronze. Tinnerman found it in Duraflex, Anaconda superfine-grain phosphor bronze. It has higher tensile strength and endurance limit for long-lasting dependability—greater formability for economical manufacture. The result: unit costs were cut—and G-E assembles controls faster, more easily.

Quality control and cost reduction can go hand in hand. The secret is often simply matching the metal to the job. And Anaconda specialists, starting with 93 standard alloys, can offer an almost unlimited number of combinations of useful properties. For creative help in meeting your problems, write The American Brass Company, Waterbury 20, Conn. In Canada; Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA

COPPER · BRASS · BRONZE NICKEL SILVER MILL PRODUCTS

Made by The American Brass Company



Fig. 1. Starrett No. 256 series disc type micrometer

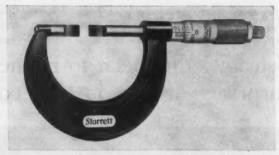


Fig. 2. Starrett No. 486 series blade type micrometer

Starrett Introduces New Precision Measuring Instruments

Precision measuring tools and instruments covering a wide field of shop and laboratory requirements were displayed at the recent tool show by the L. S. Starrett Co., Athol, Mass.

The No. 256 series disc type micrometer, Fig. 1, was exhibited for the first time as was the No. 486 series blade type micrometer, Fig. 2. The disc type micrometer is designed to solve gaging problems involving measuring the thickness of closely spaced sections with clearances as close as 0.015 inch. The blade type micrometer is designed for fast, accurate measurement of circular formed tools as well as the diameter and depth of all types of narrow grooves, slots, keyways, recesses, and shallow depths between lands and

The satin-chrome universal bevel protractor with vernier and acuteangle attachment No. C 364 series. Fig. 3, was also exhibited with the company's line of precision protractors.

On display with Starrett's line of

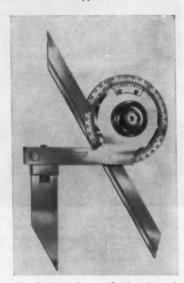
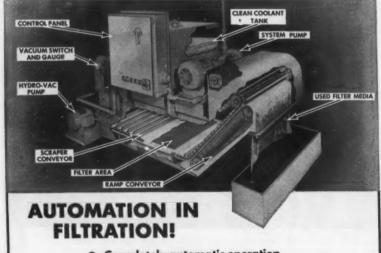


Fig. 3. Satin-chrome finish universal bevel protractor made by Starrett



- Completely automatic operation
- Used with individual machines
- Compact with low liquid inlet
- Low operating cost
- Fine degree of filtration
- Pressure and vacuum forces act on filter media
- Any coolant any sludge



19661 Schoolcraft

Detroit 23, Michigan

VErmont 8-0492

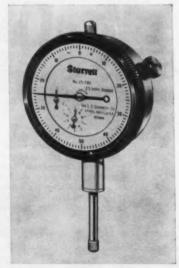


Fig. 4. Metric dial indicator displayed at show by Starrett

(Continued on page 218)



New DoALL Automatic Power Saw Delivers Cutting Accuracy Beyond Compare

Unequaled indexing accuracy and precision cutting are demonstrated by this DoALL automatic power saw. The material: Hot rolled tubing (AISI 3310) pickled, 7.109 in. o.d. with walls .856 in. thick. The cutting "team": A DoALL model C-68 automatic power saw using Demon® h.s.s. saw band and DoALL No. 240 cutting oil.

In all, 192 slices were made—every one well within flatness tolerance of .014 in. A total of 3,192 sq. in. was cut with a single saw band—without reconditioning of any kind. The cutting rate was 4.26 min./cut. This remark-

able performance proves again that you get the highest productivity with the unbeatable DoALL combination of machine—plus blade —plus coolant.

To users of power sawing equipment these advances mean important new economies in all kinds of cut-off work. Increased cutting rates give you more cuts per hour. Greater accuracy saves time on machining operations.

Call your local DoALL store today and ask a DoALL Sawing Specialist for advice on your own work. He will gladly arrange an in-plant demonstration. There is no cost or obligation.





ELDORADO*
GUN/DEEP HOLE DRILLS

Trillions and trillions of straight holes with ultra micro-finish, perfect size, absolute roundness and precision tolerance, drilled in one operation, in practically any material: steel, stainless steel, cast-iron, brass, aluminum, plastic, magnesium, titanium and other alloys. Thanks to ELDORADO production-proved DRILLS.

ELDORADO DRILLS can solve your 'hole' problem . . . small, large, short or deep, single or multiple set-ups.

ELDORADO with its modern and well equipped research facilities, constantly strives to design and develop better tools to help you eliminate your drilling problems. Avail yourself of this experience.

MADE TO YOUR SPECIFICATIONS:		AVAILABLE FROM STOCK:		
Sizes	.1250" to 2" dia.	1/8" to 1/2" dia. in 64ths	1/2" to 3/4" dia. in 32nds	
OA Lengths	4" to 120" with dia. limits	10", 16", 22", 36"	16", 22", 36"	
Drivers	Std. or to fit your need	.750" dia. x 234" long	1" dia. x 2¾" long	
Tips	Carbide	Carbide	Carbide	

Send for new literature.

Specializing 100% in Gun/Deep Hole Drills and Related Tools,



LDORADO TOOL & mfg. corp.

348 BOSTON POST ROAD . MILFORD, CONN.

dial indicators was the new No. 25-781 metric dial indicator having a 25-mm range, shown in Fig. 4. This new series indicator is available in other range and dial reading styles and with jeweled or plain (bronze-inserted) bearings.

Circle 602 on Readers' Service Card

Low-Cost Radial Drill Press

A Delta low-cost radial drill press designed to offer unusual capacity and flexibility features for its class and price range has been introduced by the Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. This machine is designed to drill to the center, or any point, of a 32-inch square and is especially adapted for rapid, multiple-drilling operations, horizontal drilling, and angular drilling. It is also capable of doing accurate sanding, shaping, routing, mortising, plug cutting, and many other operations, being particularly useful in pattern and woodworking shops.

The head swivels 360 degrees around the column and tilts more than 90 degrees to the right and left. It has four spindle speeds—



Delta radial drill press

700, 1250, 2400, and 4700 rpm for drilling a variety of materials. Controls, conveniently grouped to facilitate operation, include a degree-calibrated scale which assures accurate setting of the head for angular drilling.

Circle 603 on Readers' Service Card



The "M-15" Units used on both these machines are extremely versatile

— positive in action — trouble free — fast operating and can be mounted vertically, horizontally, or at any angle needed for specific machine designs. These Units are also available in 10 H.P. to 40 H.P. capacity to meet requirements.

When head goes from rapid traverse to feed stroke, an electric brake holds leadscrew and shuts off traverse motor — saving wear and tear. "M-15" Units are the answer to high production at lowest cost.

Machines illustrated can be arranged for both drilling and tapping. The M-15 Units are positive in operation as feed is geared directly to spindle drive gear.

Each of these machines has a completely automatic cycle for highspeed operation and a semi-automatic cycle for low-speed production and features 2 independent spindle speeds plus a neutral position for each spindle.

MECHANICAL LEADSCREW FEED

Many commendable reports

No hydraulic fluid

No fluid leaks or fluctuation

reduced

maintain unit

Positive feed thru ball-screw

SPRINGFIELD 7, MASSACHUSETTS



—says
The Hydraulic Press Mfg. Co.
A Division of Koehring Co.
of Mount Gilead, Ohio

"We have had excellent results with LUBRIPLATE in our new double crank design Henry & Wright Dieing Machines which we recently acquired from Emhart Mfg. Co., Hartford, Conn. This follows the same fine results Emhart had with LUBRIPLATE in single crank Henry & Wrights for many years. In the Operating Manual that goes with every new Henry & Wright machine, you will find that we recommend LUBRIPLATE."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.



For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.



Circle this page number on card

Numerical Tape Code Chart Speeds Numerically Positioned Setups

A tool code-chart card for use in setting up the Milwaukee-Matic enables the tool presetter operator to "read out" the tool code rings on the tool-adapter shank. The card is supplied by Kearney & Trecker Corporation of Milwaukee, Wis., for use with this machine which has numerical control built-in and automatic preset tool changing from an automatic storage turret. The machine, in selecting the tool, reads the numerical code from the preset shank rings.

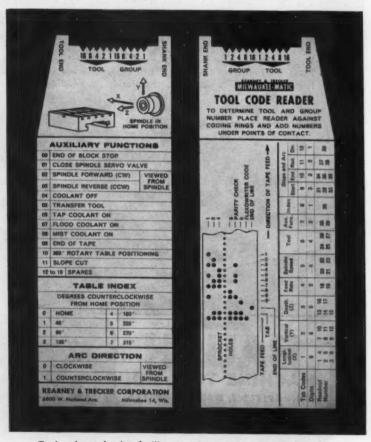
A position gage at one end of the plastic card identifies the code rings. Additional information on the card defines code numbers for the auxiliary functions of the machine, table index, and arc direction. The reverse side of the card explains the code directions on the tape, enabling easy read-out of any information on the punched tape.



Whiton quick-set chuck

Whiton Introduces Quick-Set Chuck

A quick-set chuck which can be adjusted within 0.0002 inch in thirty seconds was introduced at the tool show by Whiton Machine Co., New London, Conn. Only two screws are turned to insure positive locking of this chuck for precise accuracy during either heavy or intermittent cutting operations. The adjustable screws are on the outside surface of the chuck



Tool code reader that facilitates setting up tape-controlled machine

QUALITY CONTROL

That's the secret of good breeding . . . and why Federal Ball Bearings are all champions.

Take race grinding: the operator must gage race diameter, roundness, contour, centerline, eccentricity of raceway with O.D., parallelism of the race with the face of the bearing ring... and finish. Then line inspectors double check.

This is typical of the quality control all along the Federal production line. Double work? Sure! But it means a bearing as close to perfection as a bearing can get. One that's twice as reliable, too. That's why they're specified by so many top industrial companies. Why not put them to work yourself? Start today by sending for the Federal catalog where you'll meet hundreds of different type ball bearings...all top breed...in 12,000 sizes!

The Federal Bearings Co., Inc., Poughkeepsie, N. Y.



MANDEL



Tool Up With BEATTY For Efficient Low Cost Metal Working

Savings in metal working start with Beatty machines . . . job-engineered equipment that is especially designed to speed work flow and provide dependable, accurate performance — on the production line or on short run jobs or repair work. Beatty machines are built rugged and rigid to give more low-cost, maintenance-free production per man-hour; earn more profits per square foot of floor space and dollar investment.



WRITE FOR FREE DESCRIPTIVE LITERATURE on some of the BEATTY LINE of metal working equipment: Shears, Punches, Presses, Spacing Tables, Bulldozers, Stamping Trimmers

BEATTY MACHINE & MFG. CO.

941 150th Street, Hammond, Indiana

and are diametrically opposed by two flat springs within the chuck body which eliminates backlash. The chuck is assembled with jaws, scroll and pinions designed for production, toolroom, and directmounting applications. A number of types and sizes are available in solid and two-piece jaw designs.

Circle 605 on Readers' Service Card

Power Quills, Jig Grinder, and Hardness Tester

Precise Products Corporation, Racine, Wis., displayed three major new developments at the recent show and other important new items. Super cycle power quills were demonstrated running at constant speed under load in a range from 7200 to 54,000 rpm with up to 2-hp output available at the chuck. These new power quills were shown in three basic models which are fully interchangeable with the company's universal motor power quills. A matching line of self-contained,



Precise Model 80SC power quill

portable, high-frequency converters were also featured.

An electric jig grinder was displayed which consists of a compact, high-torque electric unit. This unit will convert any good vertical milling machine into a truly precision electric jig grinder, suitable for grinding or (with carbide) micromilling holes to toler-

Milford Rivet & Machine Company reports ...

Precision Parts Ground 20 TIMES FASTER when put on the No. 18 Blanchard

"408 precision washers, in one chuck load, now surface ground in same time as 20 by former method . . . substantial savings on all other Blanchard ground jobs . . . finished work quality outstanding . . former sub-contracted jobs now done at less cost in our own shop . . . operator fatigue practically eliminated . . . maintenance is very low."

Are you missing opportunities like these by not using Blanchards on your surface grinding jobs? Write for your copy of "Work Done on the Blanchard"

THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Mass., U. S. A.



W-1177



Now Buckeye offers two new series of compact, air-powered routers which can make deeper, heavier, faster cuts than larger electrical routers of greater horsepower. For example, Buckeye Series 61 Router cuts through 2" oak in one pass, using ½" dia. bit! Straight or intricate contour cuts can be made with speed and precision in non-ferrous metals such as aluminum and magnesium alloys, bronze, brass, stainless steels, all woods, plastic, and even honeycomb!

Both Series 61 and Series 31 feature dependable Buck-

Series 31

Both Series 61 and Series 31 feature dependable Buckeye air motor which will not burn out, even if tool stalls... lightweight, easily maneuvered base... positive-locking depth-of-cut adjustment. Available as portable units complete with base, or power unit only for fixture mounting.

write today for informative literature

and prices!

-Aircraft Model

Series 31

Duckeye Tools

P.O. BOX 966, DAYTON 1, OHIO

Pioneering Power Tools for Industry Since 1920

ances of 0.0001 inch and closer, and surface finishes well within 10 micro-inches. There were three basic models shown in operation: one with an automatic feed, a second with manual feed, and a third without feed mechanism for mounting in jig grinders now using air-driven spindles.

An "Autodrill," said to be the smallest, most compact automatic drill unit made, was included in the display. This air-hydraulic unit is electrically operated with full control of feed and stroke. It can be mounted in a vertical or horizontal position on 2-inch centers and has ample power to drill 5/16-inch holes in steel. It has a maximum stroke of 1 1/2 inches and permits spindle speeds up to 6000 rpm. Extremely compact, this unit is only 2 inches wide, 12 inches long, and 7 inches high.

Circle 606 an Readers' Service Card

Detroit Elevating Feeder

An elevator feeder for orienting and feeding parts of a variety of sizes, shapes, and materials to processing or assembling machinery has been announced by the Detroit Power Screwdriver Co., De-



Elevating feeder from Detroit Power Screwdriver Co.

troit, Mich., a subsidiary of the Link-Belt Co. The elevating conveyor can discharge parts to the right or left at desired heights. The drive is either of the fixed- or variable-speed type and can be equipped with automatic controls

straight side presses modernized to hit new performance heights



Here's smooth hydraulic action at its best! Newly modernized, the KRW 25-1000 ton line of straight side, single action presses offers you the most profitable answer to a wide range of work: bending, forming, blanking, briquetting, broaching, coining, embossing, forging, straightening and trimming.

Boasting clean-cut, neat exteriors, these versatile machines have been engineered to improve productivity . . . quantity-

wise, quality-wise and dollar-wise!

KRW's rugged, welded frame construction is unequalled for strength and rigidity. Members are keyed and fitted together to insure precision performance. Angle gibs, located at each corner of the sliding platen, maintain platen-to-bed parallelism to make utmost accuracy and longer die life a certainty.

Available with either up-acting or down-acting platens, KRW Straight Side, Single Action Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling. Compact, easy-to-adjust and fully responsive, KRW hydraulic systems assure instant, complete press control.

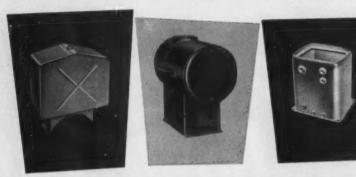
More detailed information (including specs) can be obtained by writing for illustrated Bulletin 5-B. K. R. Wilson,

Inc., 214 Main St., Arcade, N. Y.

KRW HYDRAULIC PRESSES



COMPONENT



FABRICATION

TO YOUR SPECIFICATIONS

Components and weldments of all types . . . tanks, bases, covers, guards . . . are quickly and accurately fabricated by Kirk & Blum craftsmen.

Complete facilities to ½" thicknesses in mild and stainless, aluminum, monel and other alloys.

Send your prints for prompt quotation.

KIRK

& BLUM

THE KIRK & BLUM MANUFACTURING CO., 3217 FORRER ST., CINCINNATI 9, OHIO







for "demand feeding," so that parts are fed only when needed. Standard sizes of 6-, 12-, and 20-cubicfoot holding capacities are available.

Circle 607 on Readers' Service Card

Boring-Mill Ram and Precision Spindles

Pope Machinery Corporation, Haverhill, Mass., recently completed the ram type spindle shown in the two upper views. Fig. 1, which it believes to be the longest of its type ever built-14 feet. This is a precision, heavyduty boring-mill spindle equipped with a Pope precision two-speed motor and interchangeable extension spindles (lower views). It is designed for exceptional rigidity, with shaft and bearings of excess capacity. This permits heavy cuts, and assures fine-finish ground holes and long wheel life. All rotating parts are dynamically balanced in full assembly and the bearings are permanently lubricated for life.



Fig. 1. Fourteen-foot-long Pope boring-mill rams and spindles



Fig. 2. Pope precision spindle for electrolytic grinding

Pope precision spindles for electrolytic grinding, like the one shown in Fig. 2, are now available. These spindles may be motor- or belt-driven and are available in sizes from 1 to 20 hp, with speeds of 900, 1200, 1800, and 3600 rpm. They are supplied to operate at from 50 to 3000 amperes. The spindles have

OA

9" column 3'-4' arms



9"-11" column 3'-4'-5' arms



13"-15"-17" column 4'-5'-6'-7' arms



19" column 6'-7'-8' arms



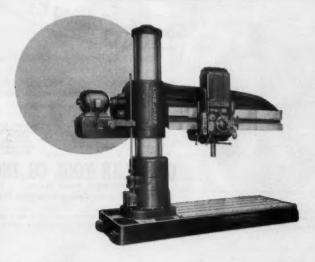
22"-26" column 7' to 12' arms

Carlton

specialists in radial drills

Carlton has specialized in radial drill research, engineering and manufacturing since 1916.
Our close contact with—and intimate knowledge of industry's drilling requirements—have produced a wide line of the most modern and up to date radial drills. Made in arm lengths from 3-ft. to 12-ft., column diameters from 9" to 26".
Programming, pre-select and manual speed-feed controls, plus special bases, tables, and jigs available for additional productivity. For further information, send today for free descriptive bulletins.

The Carlton Machine Tool Co., Cincinnati 25, Ohio.



built-in insulation and are equipped with a rugged fork type, cool-operating brush assembly for transmitting low-voltage amperage current to the grinding wheel. Detailed information on the application of these spindles is available.

Circle 608 on Readers' Service Card

Morbec Live Centers

The development of a complete line of live centers is announced by the Morbec Mfg. Co., Fort



Live center made by Morbec Mfg. Co.

Worth, Tex. With a guaranteed load accuracy of 0.0004 inch, these centers feature sealed-in-lubrication interchangeable spindles constructed of heat-treated tool steel. The shell is of one-piece

tempered, precision-ground construction and houses tapered Timken roller bearings as well as precision ball bearings. Six models are available with Morse tapers from No. 2 through No. 7.

Circle 609 on Readers' Service Card

Geared-Head Air-Powered Drill-Press Feeds

The Beckett-Harcum Co., Wilmington, Ohio, has added geared-head models to its line of airpowered drill-press feeds. The geared-head transmission units are used to obtain either a greater drill-point thrust, with shorter stroke, or a longer stroke at reduced thrust. These geared-head feeds are available in heavy-duty models with either mechanical (manual) or electrical control.

A heavy-duty, mechanicalgeared-head air feed is shown in the illustration, with the guard removed, mounted on a 1-inch capacity drilling machine. The geared power-transmission arm does not protrude beyond the spindle to interfere with the operator. The outside gears are the pick-off type and are interchangeable. Drill-point stroke and thrust can range from an 8-inch stroke at 625 pounds maximum thrust to a 2-inch stroke at 2500 pounds maximum thrust, on 1 1/4-inch pinion shaft at 100-psi air pres-

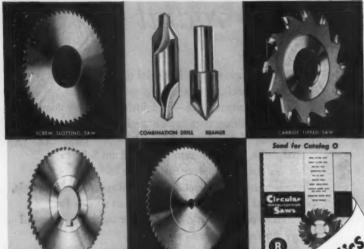
Circle 610 on Readers' Service Card



Beckett-Harcum geared-head feed mounted on drill press

(This section continued on page 230)

From More Than 1200 (R) Catalog Items...



CIRCLE R regular tooth saws are designed and heat treated for plastic's obrasive characteristics—ensure increased productivity and reduced down time for sharpening. Just one of 1200-plus catalog

items; we also design specials when required.

CHICAGO CLEVELAND DAYTON DETROIT HACKEMEACK INDIANAPOLIS MEMPHIS MILWAUKEE MONTREAL MEW MYDE PARK PHILADELPHA PHOEMIX PHOEMIX PITTSBURGH PROVIDENCE ROCHESTER

CIRCULAR TOOL CO., INC.

Specialists in Circular Cutting Tools Since 1923

MATTAL SLITTING SAWS - COPPER SLITTING SAWS - SCHEW SLOTTING SAWS - COMMUNICATION SLOTTING SAWS - SUPERLESS SLOTTING SAWS - CHT OFF SAWS - CHTCOLAR
MINTES & ROTARY SAMS - CAPOLOGY STEEL SAWS - SOLIO & THYPED TUNGSTER CARBOR SAWS - COMMUNER BRILLS & COMPRESSIONS - CRITICAL STATES



High load capacity, quiet, dependable operation and long life . . . this is what *Hoover Quality* means to you. Hoover cylindrical roller bearings combine performance-proven design features with the finest materials and craftsmanship to assure superior bearing performance.

Only Hoover provides the exceptional smoothness of *Hoover Honed* raceways and rollers, the strength and accurate guidance of machined bronze retainers. Hoover cylindrical roller bearings are available in a wide range of sizes and series. Return the coupon below for complete information.

hoover quality . . . WHERE IT COUNTS MOST



Hoover Honed raceways are polished to mirror smoothness. Raceways are precision matched with rollers for low operating temperatures and long life.



Hoover Honed rollers are crowned to provide uniform load distribution and reduce friction. Cool running, they permit high speed operation under heavy radial loads.



Machined retainers are made of solidbronze for strength. Precision construction assures accurate roller guidance and proper spacing for uniform load distribution.

Hoover Honed is a Hoover Trademark

BALL AND BEARING COMPANY 5400 South State Road, Ann Arbor, Michigan

Zone Sales
Offices and
Warehouses

8581 South Chicago, Chicago 17, Illinois 290 Lodi Street, Hackensack, New Jersey 2020 South Figueroa, Los Angeles 7, California

Hoover Ball and Bearing 5400 South State Road,	Company Ion Arbor, Michigan
Please send me new Bulle	in No. 114 which describes Hoover cylindrical roller bearing
Name	
Title	
Company	STREET, STREET
Address	



It's easy to do when you let Columbus Die-Tool handle your special tooling problems.

Many leading companies all over the United States are now availing themselves of our creative engineering staff, modern plant and equipment, to design and build their special tools, jigs, fixtures and machines. Over 50,000 square feet filled with precision production equipment enables us to build fine tools and special purpose machines to your exacting requirements. Increase the efficiency of your operation with special tools that do the job better-faster-more economically . . . designed and made by Columbus Die-Tool.

FREE: New brochure listing complete facilities and equipment. Write today.

Columbus Die-Tool



230

P.O. BOX 750 . COLUMBUS, OHIO SERVING INDUSTRY SINCE 1906

Designers and manufacturers of Jigs . Fixtures . Special Tools . Units for Machine Tools . Builders of Machine Tools Complete



Morrison cross-slide rotary table

Cross-Slide Rotary Table

The Morrison Machinery & Engineering Corporation, Chicago, Ill., has introduced a cross-slide rotary table. This rugged, highprecision tool is designed to reduce setup time for machining stamping, forging, and die-cast dies; cams; templates; rubber and plastic molds; tools; gages; models; and fixtures. It is especially adapted for experimental boring and grinding work.

Once located and clamped on the cross-slide, it is rarely necessary to move or re-clamp the workpiece until all cuts are completed. The cross-slides can be adjusted in seconds to position the work for cutting any radius whose center point lies within a 9-inch-square area centered on the table. All dimension points are kept in exact relationship to each other.

Circle 611 on Readers' Service Card



Briney special boring quill

Precision Boring Quills

The flexibility of design possible with the patented Briney principle of ultra-fine tool adjustment has been featured by the Briney Mfg. Co., Pontiac, Mich., in announcing their special precision boring quills. The Briney principle allows tools to be adjusted to accuracy



A ROOMFUL of **THOMPSON GRINDERS**



This is the eighth Thompson grinder recently installed at Jessop which grinds plates and sheets up to $60^{\prime\prime}\times96^{\prime\prime}$ in size.

Jessop precision ground flat stock which is used in gages, dies, verniers and other exacting products.

Pictured above are 4 Thompson Grinders in the Specialties Division of Jessop Steel Company, Washington, Pennsylvania. There are 4 more Thompsons which are not shown in the above photo. All these Thompson machines are grinding to the extremely accurate tolerances and fine RMS finishes that distinguish Jessop's precision ground flat stock.

There are excellent reasons for using 8 Thompsons on this essential production. Mr. Joseph Manfredi, who is responsible for the quality and production of this famous ground flat stock, says, "We have recently installed our eighth Thompson grinder in this division. We have proven the top performance of these rugged machines for many years. They give us the extreme accuracy and precision we demand—day after day with a minimum of maintenance."

You may not need 8 Thompson grinders in your operations but it will pay you well to investigate what just one Thompson machine can do toward saving time, improving your products and cutting your costs of manufacture.

Your inquiries are invited.

THE THOMPSON GRINDER CO. SPRINGFIELD, OHIO

nompson_in mind for that daily grind"





ALLEN is the dowel pin that gives you PLUSES!

Your ALLEN Industrial Distributor can show you a good many ways to use ALLEN Dowel Pins, in addition to conventional uses in tool and die work. You can use them as economical roller bearings, axles, precision plugs, hinge and wrist pins—and in many other ways.

You can cut the cost of your product substantially, too—because your ALLEN Distributor can supply these strong, accurate, mirror-finished Dowel Pins in standard sizes right from stock.

Made of special Allenoy steel; surface hardened to 62-64 Rockwell C; precision ground to .0001" with micro-inch finish of 6 RMS max. Check your Allen Handbook or Catalog for detailed specs and standard sizes, or write direct for samples and technical information.



Genuine ALLEN products are available only through your ALLEN Distributor—he's always ready, willing and able to give you prompt, practical service.



ALLEN MANUFACTURING COMPANY

HARTFORD 1, CONNECTICUT, U.S.A.

limits of 0.0001 inch without loosening or tightening screws such as are generally used for holding tool bits in conventionally designed

Boring quills for special applications incorporating the Briney principle are not limited to single tool adjustment. Various adjustment combinations can be used as required. Displayed at the exhibit were: quills for outside-diameter turning and inside-diameter boring with depth control adjustments, and quills with automatic retraction and feed-out and block type tooling for precision boring and turning on multiple-purpose vertical- or horizontal-bed machines.

Anti-friction arbor-support bearings and bearings that allow spindles to travel in combined linear-radial motion were also exhibited, in addition to the complete line of standard quills.

Circle 612 on Readers' Service Card

Versatile Automatic Screwdriver

Screw patterns can be quickly changed on the new "R-A-F" (Rapid Automatic Fastening) screwdriver manufactured by Ingersoll-Rand Co., New York, N. Y., by loosening and tightening only two bolts per power-head. The R-A-F drives practically any number of screws in practically any production pattern to meet the demands of the fastest assembly lines. This screwdriver runs screws in one and one-half seconds.

Three power ranges are provided



Ingersoll-Rand automatic screwdriver



the red tape that cuts costs...

kearney & Trecker MILWAUKEE-MATIC
with speed and accuracy far beyond
human ability. Modern control is just
a part of the new MILWAUKEE-MATIC
manufacturing concept that changes
production schedules from Months to
Minutes. The MILWAUKEE-MATIC is
a complete machining center which
unifies milling, drilling, boring, reaming
and tapping operations into a single,
numerically controlled unit.

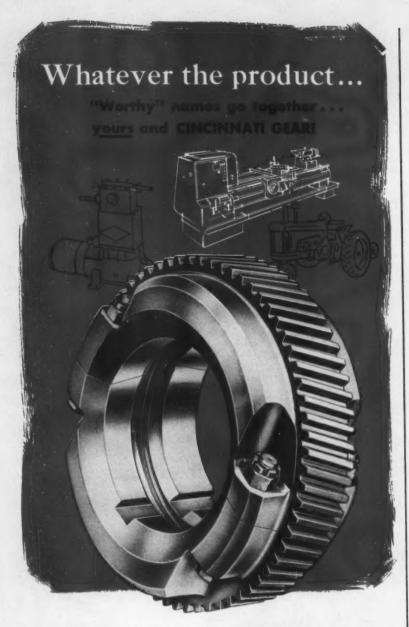
Write for complete literature file, or call your local Kearney & Trecker representative today.



Numerical Control Division



6800 West National Avenue • Milwaukee 14, Wisconsin Phone - GReenfield 6-8300... Direct Distance Dialing Code No. 414



This trademark on a gear is the GUARANTEE of a quality-conscious gear manufacturer.

CINCINNATI GEAR has kept in the forefront of technological progress in gear-making methods and equipment for over 50 years. The oldest "tool" in our ultra-modern shop is *pride in true craftsmanship!*

Send us your prints for quotation.



THE CINCINNATI GEAR CO.

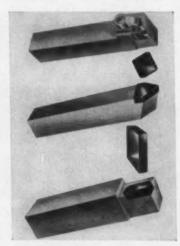
Wooster Pike and Mariemont Ave. Cincinnati 27, Ohio Custom Gear Makers Since 1907

GEARS, good gears only

by three different "Multi-Vane" air motors for precise, predetermined torque control. In each power range, the motors run to stall, driving screws to a preset, accurate torque. Power-heads can be located as closely as 2 inches center-to-center and can be added or removed easily. Most all common screw types can be used on standard R-A-F screwdrivers. Special hard-to-feed screws can be handled with minor adaptations in many cases. Standard vibratory or barrel feeders are used, each feeding up to four power-heads.

The column is only 42 3/8 inches high and is designed for compact, production-line installation. Standard bases measure 24 by 24 inches, but larger bases can be furnished for mounting larger fixtures. Throat depth ranges from 8 5/32 to 14 inches from center line of power-head to column. This clearance allows ample room to handle a wide variety of jobs. The power-head stroke is adjustable up to 6 inches, which is more than adequate for long screws and special applications.

Circle 613 on Readers' Service Card



Besly-Welles tools incorporating Kennametal material

Carbide Tools

The Besly-Welles Corporation, South Beloit, Ill., has added to its line of grinders, cutting tools, and gages a full line of carbide single-point tools, blanks, inserts, and holders using Kennametal material exclusively, in Besly grade designations.

Circle 614 on Readers' Service Card (This section continued on page 236) 6 Features that make a big difference in counterboring operations!



1. HAND DETACHABLE . . . a twist of the wrist engages or releases the cutter after the severest cutting operation.



4. BALANCED DRIVE . . . double bearings-one on each side of drive lugprovide extra rigidity.



2. STURDY DRIVE . . . diametrically opposed drive lugs engage corresponding abutments in the holder.



5. FREE FROM OBSTRUCTIONS . . . holder body slips easily into a bushing or can be threaded for stop nuts or collars or fluted for lubrication.



3. EXTRA TORSIONAL RIGIDITY . . . drive lugs are close to seating shoulder of cutter for powerful, smooth operation.



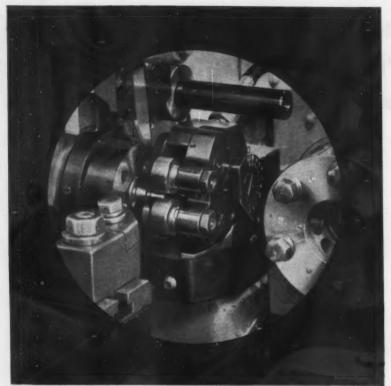
6. PRACTICALLY INDESTRUCTIBLE . . . no binding, no shearing-driving forces apply compression.



These are the features that make the difference in counterbores-six reasons why no one reports failure of a Continental Counterbore Drive!



TOOL WORKS
DIVISION OF



MODEL B

New Thread Rolling Attachment for # 00 Brown & Sharpe

- Reduces Pressure on Spindle
- Produces Higher Quality Threads on steel, brass and aluminum
- Increases Threading Capabilities
- Eliminates Secondary Operations by Threading Behind Shoulders
- Threads Rolled Close to Collet
- Reduces Inspection Costs

With this latest Reed Attachment the threading capacity of your \$00 Brown & Sharpe can be greatly increased. The attachment has a diameter capacity of up to % inch and maximum thread length of ½ inch. It is easy to set up and operate and precision adjustments assure accurate matching and positioning.



REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment HOLDEN, MASSACHUSETTS, U. S. A.

Sales Offices int Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

Airco All-Purpose Utility Torch Kit

A propane-fueled torch kit is now available through Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Called the "Bernz-O-Matic," this equipment can be used for soft soldering, paint burning, copper-tube sweating, jewelry making, and general applications requiring heat. The many advantages to users claimed for Bernz-O-Matic torches include: instant starting, long burning (up to fifteen hours with one cylinder), self-sealing valves, no hoses required, allposition burning, and disposable cylinders. Bernz-O-Matic is available in single cylinders with push-



Bernz-O-Matic propane-fueled all-purpose utility torch kit

button to pencil type tip assemblies, or in carry-all kits which include accessories.

Circle 615 on Readers' Service Card

Kendex Wheel-Boring Tools

Kendex wheel-boring tools with screw-on type round button inserts are announced by Kennametal Inc., Latrobe, Pa. The new Style RWR roughing holders fit standard four-tool type "L" boring bars for rough boring.

Standard Style CDH-42 heavyduty Kendex inserts with 1-inch diameter cutting edge can be rotated to a new edge without disturbing the holder setting. They can be resharpened easily by grinding the top surface. Nearly all requirements can be met with eleven holders which are stocked.

Circle 616 on Readers' Service Card (This section continued on page 238)



A new COMPUTER (the latest BENDIX Alpha-Numerical type) has enabled us to greatly accelerate our continuing program of basic research in both gear and broaching practice.

Another important advantage of this equipment is utilized in the day to day design of individual shaving cutters and honing tools to meet certain specified operating conditions. With the computer, all of the many design possibilities are rapidly evaluated in order to be sure of the very best selection.

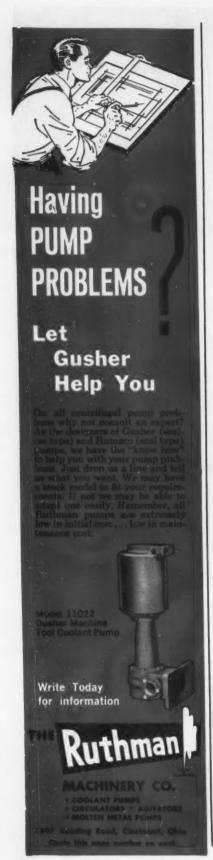
Red Ring engineering know-how plus high-speed electronic calculation is your assurance of the most effective tooling for your own production needs.

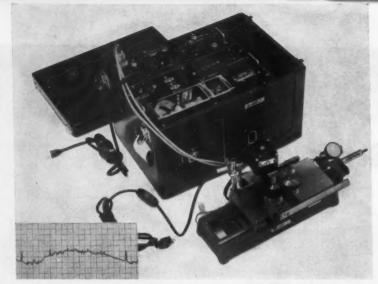
Write for Bulletin CAP 57-11



NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN
WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT





* Electronic gear-testing machine introduced by Scherr-Tumico Co.

Electronic Gear Tester

The Scherr-Tumico Co., New York City, is introducing an electronic gear tester using the Sanborn electronic recorder coupled with either the Scherr 2-inch or 5-inch model or the Parkson 9- and 15-inch sizes.

The Scherr-Tumico electronic recorder can be calibrated to any ratio within the limit of the recording tape. One line on the paper can be made to equal from 0.00005 to 0.001 inch depending upon the pitch of the gear being checked. A motor can be furnished to drive the gear being checked. This motor can be wired to the switch that controls the recording tape so that

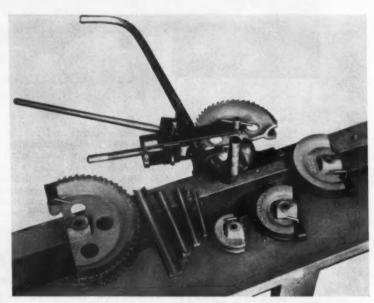
both gear and tape operate in unison, or it can be hooked up to an independent switch if desired.

The recorder uses no ink, since it operates with an electrically heated stylus. By the simple adjustment of a knob the stylus temperature can be adjusted to give a fine or a heavy line. Gears can either be checked in pairs or against a master gear, in which case a master gear for each pitch is required.

Circle 617 on Readers' Service Card

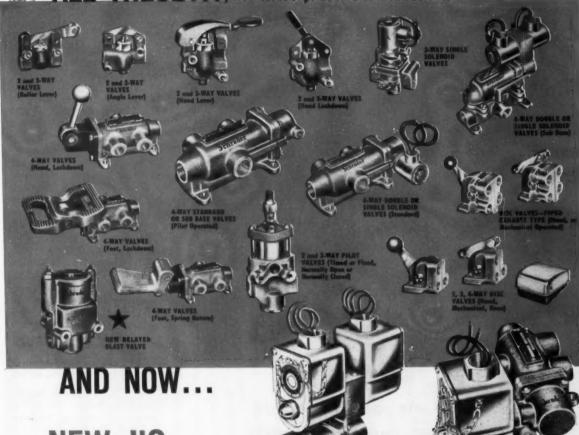
Wallace Bench Bender

A bench bender designed for repair or maintenance work and onthe-job applications has been announced by the Wallace Supplies



Bench bender announced by the Wallace Supplies Mfg. Co.

ALL THESE ... full lines from Schrader...



NEW JIC SOLENOID AIR VALVES

that meet and exceed JIC specifications

SUB-BASE available in single solenoid, 4-way; double

olenoid, 4-way.

New JIC Solenoid Valves are compact, rugged, fast-and-easy to install. Roomy junction boxes fit space requirements with 90° rotation. Can be operated in case of current failure, by hand. Safe, recessed override button prevents accidental operation. Electrical system completely sealed against dust, oil.

available in single solenoid, 3-way;

single solenoid, 4-way; double

Schrader's complete line of air valves allow you a freer hand in planning air circuits for your applications. Besides almost unlimited choice of size, style and actuation method, you get these extras in every Schrader valve you buy:

- All parts are designed for maximum air flow, longest service life; simplicity of replacement; interchangeability.
- Schrader Valves feature tough, practical design, precision construction, and are individually tested to full ratings.

 Performance has been proved by years of use in hundreds of plants. All Schrader Valves can operate with Schrader (JIC) Square End Cylinders perfectly.

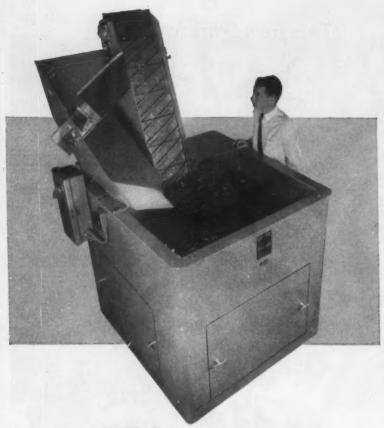
Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

A. SCHRADER'S SON

Division of Scovill Manufacturing Company, Incorporated 454 Vanderbilt Avenue, Brooklyn 38, N. Y.



QUALITY AIR CONTROL PRODUCTS



How DPS elevating feeders elevate, orient, feed your parts to cut production costs

New elevating feeders from Detroit Power Screwdriver Company—

- · Eliminate hand feeding
- · Permit high-speed feeding and orienting
- Discharge parts at height to suit your requirements
- · Offer adequate holding capacity

The output of hand-fed production machinery soars with DPS elevating feeders. Parts of almost any size, shape and material can be fed quickly, gently, in a continuous flow to other machinery for processing and assembly.

Three standard sizes available: 6, 12 and 20 cu. ft. holding capacities. Larger or smaller units can be fabricated to meet special requirements.



NEW BULLETIN

. . . has complete information on new DPS elevating feeders. Mail the coupon today!



A Subsidiary of Link-Belt Company

	ort St., Detroit 16, Michigan
Send nev	v Elevating Feeder Folder 2812.
NAME	
FIRM	

Mfg. Co., Chicago, Ill. This T-3 bench bender has direct lever operation for bending soft copper and aluminum up to 1 1/2 inches in diameter, and for bending annealed steel tubes up to 1 inch outside diameter. It is especially adapted for hydraulic line work and copper water-pipe systems.

The ratchet bending-action capacity for steel tubes is 11/2 inches. The two ratchet-bender dies with outside diameters of 1 1/4 and 1 1/2 inches have cast-in ratchet teeth with ratchet lever attachment which gives one man the power equivalent of two men. This bench bender uses the "compression" type of bending which gives shorter radii without using a mandrel and requires less hand power (it rolls the bend in). It can be used for right- or left-hand bending with tangents of about one tube diameter between bends. Five complete sets of dies are available with outside diameters ranging from 1/2 to 11/2 inches. Net weight of the bender is 117 pounds.

Circle 618 on Readers' Service Card

Landis Thread-Rolling Head

No. 3 1/2 series thread - rolling head manufactured in two styles, stationary and revolving, by Landis Machine Co., Waynesboro, Pa., to cover a UNC and UNF range from 1/4 to 7/16 inch. These heads are designed to withstand the rigors of continuous high



production. The stationary head is adaptable to turret lathes, hand screw machines and automatic screw machines employing stationary heads. The revolving head is for application to automatic screw machines utilizing a revolving type tool. In addition, they can be applied to threading, drilling, and tapping machines. The heads fea-



in a Custom-Quality Press

Take your choice of dependable Danly SC crankshaft presses in capacities from 50 to 300 tons...bed areas to 72" x 60"...with strokes to 16"...constant or variable speeds to 90 SPM... with non-geared, single or double-geared drives...equipped for manual or automatic feed.

Every SC press gives you Danly's patented low-maintenance air-friction

Take your choice of dependable Danly clutch, husky welded-steel frame, and SC crankshaft presses in capacities countless other custom-quality feafrom 50 to 300 tons...bed areas to tures.

For low-cost piece part production ... in blanking, drawing, piercing, forming, or progressive die stamping... you'll find your choice of Danly SC Presses ahead of the field and best for you. WRITE FOR NEW SC CATALOG and get all the details.





DANIX



DANLY MACHINE SPECIALTIES, INC., 2100 S. LARAMIE AVE., CHICAGO 50, ILLINOIS



When any of the various functions for which this machine is designed are performed on it, no further machining is required. The job is finished.

The basic "1-2-3" method—exclusive with Goss & DeLeeuw—provides for gripping work in the chuck and machining all ends either simultane-

ously or in sequence. By eliminating several handlings and set-ups, the "1-2-3" method produces finished pieces at a fraction of the time and cost ordinarily required.

Send samples of your work for time estimates. Ask for illustrated literature containing detailed information.



ALTRICITORSAL

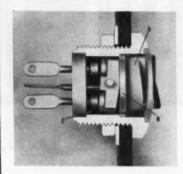
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

ture replaceable helix-angle bushings. By the use of a "mean" angle, one set of standard bushings is sufficient to roll all UNF and UNC threads within the range of the head. When an application necessitates an exact helix angle, the proper helix angle bushings can be substituted, eliminating the need for a special head.

Circle 619 on Readers' Service Card

Magnet-Actuated Switch

A miniature switch that is actuated by a permanent magnet is claimed to bring optimum reliability to electrical circuits of automated machine tools, dataprocessing systems, ordnance devices, etc. Developed by Space Components, Inc., Washington, D.C., the "FluxLink" is designed to operate through a range of temperatures from minus 65 to 900 degrees F. As can be seen in the illustration, the flux, or force, inherent in the magnet A is piped through a solid metal barrier B into a hermetically sealed cham-



ber C containing the make-andbreak electrical contacts. There are no springs, and there is no physical contact between the magnet and the chamber interior. The switch has only one moving part inside the chamber. Being hermetically sealed, the chamber is impervious to heat and cold, and the switch can function underwater or in corrosive or explosive atmospheres. It can serve without modification for toggle, rotary, lever, push-button, or electromagnetic remote control. Three service series are presently available, all operating on 15-ampere, 125-volt alternating current. Outside diameter is 3/4 inch, and over-all length is 5/8 inch.

Circle 620 on Readers' Service Card (This section continued on page 244)



Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA

. Export Distributor: Bethlehom Stnet Export Corporation



Fabricator Reduces Punching Costs by Changing to Omega Tool Steel

This picture, taken at Dave Steel Co., Asheville, N. C., shows Bethlehem Omega tool steel punching a ½-in. diam hole in a structural angle about ¾-in. thick. The fabricator reported that the Omega performed as though the structural steel were so much butter. It produced thousands of clean, burr-free holes of uniform size, resulting in an 18 pet reduction in punching costs, as compared with the grade formerly used.

Omega is our "super" grade of oilhardening, shock-resisting tool steel. In addition to being a long-wearing grade, Omega offers maximum shock-resistance for hardnesses up to Rockwell C-59.

Omega tool steel can be quenched in oil at 1625 F. It also offers the advantage of water quenching from 1550 F.

TYPICAL ANALYSIS

C	Mn	Si	Mo	V
0.60	0.70	1.85	0.45	0.20
Besid	des its use i	n punche	s, Omega	is also
ideal	for calking	ng tools,	beading	tools,
shear	r blades a	nd chipp	oing chis	els—in
fact,	any severe	service i	nvolving	drastic
and	repeated in	pact.		

If you would like full details on Omega tool steel, get in touch with your Bethlehem tool steel distributor.

BETHLEHEM TOOL STEEL ENGINEER SAYS:



Pack Hardening Tools? Be Sure to Use a Thermocouple

When pack hardening tools to reduce scaling and decarburization, it's a good idea to place a thermocouple in the pack, against the tools, to check accurately the time the tools are at heat. Failure to do so may lead to trouble.

For example, an experienced heattreater pack hardened a large-diameter die ring made of Bethlehem Lehigh H tool steel. Then he checked the hardness. Imagine his surprise to find it was only Rockwell C-48. Puzzled, he checked the furnace pyrometer charts. They showed that the recommended heating cycle had been followed. But why such a low hardness?

A Bethlehem contact metallurgist suggested that the die ring be rehardened, and that a thermocouple be inserted in the pack against the ring. After this was done, and the cycle repeated, the hardness jumped to Rockwell C-60. It was noted that the time required to heat the tool was 50 pet greater than in the first cycle. Thus the heat-treater had proof that in the initial treatment, the die ring was not heated long enough to reach proper temperature, despite the fact that the furnace pyrometer apparently indicated the correct heating cycle.



Upset-forged Discs Are Easy To Machine

Bethlehem upset-forged discs, made of Cromo-WV (H-12) tool steel, are ideal for aluminum extrusions tooling because of the basic 5 pct chromotonary of their easy machinability, and ease of heat-treatment. They're made with exacting care, and are finished in ring dies to insure good section and sharp edges. Moreover, Cromo-WV has good resistance to washing and heat checking.

WHY E

Microhoning* Transmission Gears Simplifies & Improves Production

Improved product performance and simplified processing – two major factors that are accelerating the swing to Microhoning. Typical of this swing is a major manufacturer of regular and compact automobiles. In the processing of gears for automatic transmissions, this company selected Microhoning for a number of flat surfaces, bores and O.D. of a housing hub—HERE'S WHY!

SIMPLIFIES PROCESSING

Double surface Microflat machines simultaneously Microhone both flat surfaces of pinion and sun gears—first, to obtain proper thickness and parallelism on soft gear blanks. This simplifies subsequent operations (boring, hobbing, chamferring, etc.) by eliminating former orienting of gears to a single finished surface.

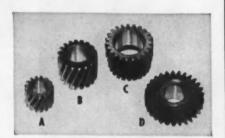
The second Microhoning of these flat surfaces, after heat-treating to 59 R "C", quickly removes all burrs and generates final accuracies and surface finish.

EFFICIENT PRODUCTION

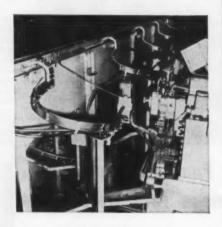
After the second flat-Microhoning operation, gears are conveyed to Microhoners for processing the bores. Typical, of the production efficiency realized on all gear bores, is the bore-Microhoning of pinion gears (nine are used in each large transmission).

On eight Microhoners these pinion gears are automatically loaded, positioned, bores Microhoned, checked for size, segregated and ejected (see photo to right). This wholly automatic sequence takes about 18 seconds per gear. Only one set up man is required to keep all eight machines in operation.

An average of .002" stock is removed from each bore; generated surface finish is 10 microinches, rms; roundness and straightness are held within .0001" tolerance;



"A"-pinion gear for large transmission
"B", "C" & "D"-pinion and sun gears
for compact car transmission



diameter within .0003". Comparable results are obtained on other gear bores (see facing page).

This efficient precision production assures consistent results. Also, reliable precision on component parts is a prime answer to "Why" better performing automatic transmissions are obtained.

*Registered U.S. Pat. Off.



MICROMATIC HONE CORP.



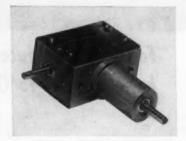
Small Size Permanent Magnet Chucks

The O. S. Walker Co., Inc., Worcester, Mass., is manufacturing three permanent magnetic chucks of the design illustrated. These chucks are made in 4- by 4-inch, 4- by 8-inch, and 6- by 6-inch sizes. All three chucks offer the principal features of larger chucks in the manufacturer's line, including ceramic magnets, all steel face, light weight, low height, and fine pole divisions. Their small size makes them particularly useful for toolroom setups.

Circle 621 an Readers' Service Card

Miniature Right-Angle Miter Gear-Boxes

One of a complete line of miniature miter gear-boxes assembled, with precision ball bearings, brought out by Pic Design Corporation, a subsidiary of Benrus



Watch Co., Inc., East Rockaway, L. I., N. Y. The approximate overall size is 7/8 by 1 1/2 by 2 inches. Available from stock, these "BA" type units are of stainless steel with anodized aluminum frame. They are ideal for getting drives around corners. The precision miter gears have a minimum backlash of better than 10 minutes of angle, with variable mounting combinations.

Circle 622 on Readers' Service Card

L-W Chuck Dividing Head with Direct Indexing

Direct-indexing head available for all models of L-W chuck dividing heads made by the L-W Chuck



Co., Toledo, Ohio. The models with direct indexing permit changing from conventional indexing to direct indexing in less than a minute. Worm-and-wheel adjustment eliminates backlash. An index-plate with twenty-four slots is standard equipment with direct-indexing models. Machine blanks can also be furnished.

Circle 623 on Readers' Service Card

Solenoid-Operated Air Valve

One of a series of versatile directsolenoid-operated air valves embodying numerous innovations, announced by Mechanical Air Controls, Inc., Detroit, Mich. The line includes single- and double-solenoid, four-way, three-way, and four-way five-port types in 1/4-, 3/8-, and 3/4-inch sizes. All valves come complete with prewired bodies and bases. The valve body simply plugs into the base to complete the electrical connections. In addition to automatic operation, manual screwdriver or ball type operators are standard on all sole-



MACHINERY, May, 1960

HOW MAN

Microhoning* Transmission Gears Simplifies & Improves Production

A major manufacturer of regular and compact cars has selected Microhoning as the most efficient method for securing consistent precision, controlled surface finishes, and simplified processing. Microhoning is used on the flat surfaces and bores of a number of transmission gears plus the O.D. of a housing hub. HERE'S HOW!





Flat-Microhoning small transmission gears—head is swung to left for easy loading.



Bore-Microhoning-both spindles fed simultaneously.

FLAT-MICROHONING

Both faces of a variety of transmission gears are simultaneously Microhoned. First, soft gear blanks are flat-Microhoned to secure proper thickness and parallelism within .0003", and a finish of 30 microinches (rms) or better. This simplifies subsequent processing by eliminating formerly required orienting of part to only one finished face.

The second flat-Microhoning of faces, after heat-treating to 59 R "C", quickly cleans up all burrs while generating final accuracies and finishes.

BORE-MICROHONING

The Microhoning of bores for large transmissions is described on facing page. The smaller transmission uses pinion and sun gears having various bore sizes (.697"D. x 3/4"L., .697"D. x 1-3/32"L., 1.030"D. x 7/8"L.). To generate roundness, straightness, size and surface finish, these bores are processed on double-spindle Microhoners equipped with shuttle-type fixturing. Straightness and roundness are held within a .0003" tolerance, diametric size within .0005". All gear bores are processed in an average 26-second cycle that includes loading, Microhoning and ejection.

O.D.-MICROHONING

The converter housing hub of the large transmission is also Microhoned. Hub O.D. is 1.936", length is about 2", and it has a blind end with 1/4" relief. Two progressive Microhoning operations remove a total of about .004" stock to generate a surface finish of 15 microinches in a cycle time of 45 seconds per part. Special Microhoning technique generates circumferential lay on hub O.D. to provide compatibility between it and oil seal rotation. This increases seal life and effectiveness.

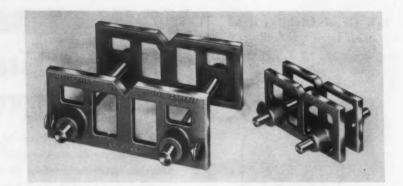
*Registered U.S. Pat. Off.



MICROMATIC HONE CORP.

noids. Valves also can be set to either "locked-in" or "locked-out" position with the control. They thus can be cycled manually to facilitate machine setup, etc. All valves are equipped with new "MACsolenoids," which require no tools to assemble or disassemble. Further, all solenoids are interchangeable among all valves of the same port size. "Add-a-unit" manifold type bases are available for 1/4-inch models, permitting the ganging of two to ten valves.

Circle 624 on Readers' Service Card





PLAIN AND

UNIVERSAL

MODELS

Wide range of speed/feed combinations for any type material, any type job.

 Heavy, internally ribbed column casting and heavy duty rectangular everarm for maximum rigidity.

 Large, heavy-duty knee, saddle and table provide accuracy for all types of milling.

New 7½ HP spindle drive meter, with separate motor for movable components, provides extra power for heavy milling.

 Easy-to-reach controls. Handwheels and vertical crank disengage automatically when not in use.

 New rapid traverse lever within operating control area

 Separate drive motor for table, saddle and knee provides more smooth balanced power at the cutter.

Adjustable Parallels

Readily adjustable Threadwell "Little Champ" parallels, designed for use as complementary holding devices on drill and arbor presses, as well as to support work on surface plates, machine beds, work benches, or tables. They may be used free or secured and can be mounted with jigs or fixtures designed for specific long-run operations. Available in two linear sizes, 3 by 6 inches and 4 by 10 inches, from Threadwell Tap & Die Co., Greenfield, Mass. Their spread is limited only by the length of the connecting bars. The bars supplied by Threadwell are centerless ground for maximum concentricity in standard lengths of 6 inches for Model A, and 10 inches for Model B. Members may be used with hubs facing in or out.

Circle 625 on Readers' Service Card



DoALL Left-Hand Tap Set

Set of ten new high-speed steel, ground-thread taps for tapping left-hand threads available from DoALL Company, Des Plaines, Ill. The set covers a size range from 1/4 to 1/2 inch and is available in both N.C. and N.F. thread.

Circle 626 on Readers' Service Card (This section continued on page 248)



Write for detailed literature!

for spindle drive; a sepa-

rate motor for moving

table, saddle and knee. Compare this and the other

outstanding features of the

new Greaves Mill. You'll

see why Greaves is "The

MOST Mill for the LEAST

Money."

J. A. FAY & EGAN COMPANY 2500 Eastern Avenue, Cincinnati 2, Ohio

ARMSTRONG

TOOL HOLDERS

A Correct Tool for Every Lathe Operation

You can save time (and money) by ensuring that your machine tools are equipped with adequate numbers of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for every standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs.
Write for literature.



ARMSTRONG BROS. TOOL CO. 5213 W. ARMSTRONG AVE. CHICAGO 46, ILL.

"SHORE

HARDNESS TESTING



Shore's Improved Direct Reading Scleroscope (above) and Standard Recording Scleroscope (below) with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.

Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

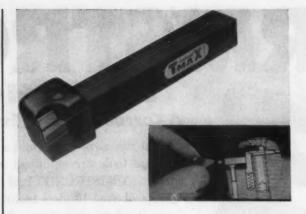
Standard Recording Scleroscope (right) with Clamping Stand, jaw capacity 3" high x 21/1" deep. Sup-plied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.

248



THE SHORE INSTRUMENT and MANUFACTURING Co., Inc. 90-35 Van Wyck Expressway, Jamaica 35, N. Y

Circle this page number on card



Sandvik T-Max throw-away type easily adjusted tool-holder

Carbide Tool-Holder

Sandvik Steel, Inc., Fair Lawn, N. J., exhibited at the tool show their entire line of "Coromant" carbide tooling, including their "T-Max" throw-away type, adjustable tool-holder. This tool-holder has a solid-carbide chip-breaker which can be adjusted for light, medium, or heavy cuts by simply pushing it into position.

A special newly devised feature of this holder is the "Auto-Lift," spring-loaded pin which automatically lifts and holds both the threeposition chip-breaker and the clamp clear of the insert for quick, fumble-free indexing or replacement of the insert. Another trouble-preventing feature is the "non-binding" shim pin, which is a tempered spring pin which cannot freeze or bind from machining

A variety of T-Max styles and sizes in positive- and negative-rake holders were also exhibited. Other items in the Coromant line which were displayed included blanks, inserts, cutters, scrapers, combination cutters with T-Max disposable type blades, shell end mills, and brazed single-point tools.

Circle 627 on Readers' Service Card

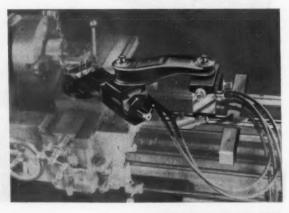
True-Trace Lathe Attachment

A tracing attachment for lathes, called the Model "Mark II," was shown for the first time at the ASTME Tool Show by True-Trace Corporation of El Monte, Calif. This attachment is offered as an 'off the shelf" type of application. No machine conversion is required as it requires only minutes to install or remove. Of the pivot type design, this device is suitable for both shaft and facing duplication. It is entirely hydraulic.

Another tracing attachment for turning applications called "Synchro/Traceturn" was also introduced. This attachment is designed to duplicate 90-degree shoulders. It operates at a uniform feed rate, regardless of the shape of the pattern or master being duplicated.

Circle 628 on Readers' Service Card (This section continued on page 250)

Mark II pivot type lathe tracer attachment introduced by the True-Trace Corporation





"Toughest" inspection in the steel business assures you utmost uniformity in Timken forging steels

You can always be sure your forged products made from Timken® steel forging bars will have uniform quality. One big reason is the rigid, 100% Final Inspection we give every bar. Examination is so thorough that our Inspection Department is known as the toughest in the steel business.

You save money, too, because of the uniform quality of Timken steel. It is remarkably uniform in structure, chemistry and dimension from heat to heat, bar to bar, order to order. And because we handle each order individually, we can target our procedures to your end-use requirements. You don't have to interrupt your operations to make costly equipment adjustments.

Important to our operations is a new Metallurgical

Research Center, one of industry's most modern. Its facilities range all the way from an experimental melting laboratory to one of the industry's finest technical libraries. It is designed not only to improve our own products but also to solve customer problems—your problems.

When you buy Timken steel you get: 1) Quality that's uniform from heat to heat, har to har, order to order.
2) Service from the experts in specialty steels. 3) Over 40 years experience in solving tough steel problems.

For the most from your modern forging operations, specify Timken steel forging bars. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.

TIMKEN ALLOY STEEL AND SEAMLESS TUBING ARE AVAILABLE FROM WAREHOUSE STOCKS IN 44 CITIES IN THE UNITED STATES



executive or group showing . . . or write for a copy of the booklet. "The Automatic Production of Forgings in Closed Dies". It may help shape your forging plans for tomorrow.

CHAMBERSBURG ENGINEERING COMPANY Chambersburg Pennsylvania

CHAMBERSBURG

• The Hammer Builders •

DESIGNERS AND MANUFACTURERS OF THE IMPACTER

When it's a vital part, design it to be





"Miracle Movement" Dial Indicators

Federal Products Corporation, Providence, R. I., is making a dial indicator whose movement mechanism is said to greatly improve resistance to wear and shock, reducing maintenance costs by as much as 80 per cent. This instrument, known as the "Miracle Movement Indicator," is identified by the special symbol here illustrated which appears on both the dial and the movement plate. The indicator is the result of recent improvements in a special process developed for producing key parts with sufficient toughness to provide protection against shock without the need for any additional cushioning devices, as were necessary in the past. The new movement is interchangeable with the indicator movement it supersedes and is available with either full-jeweled or plain bearings. It is now furnished on all regular, perpendicular, "wetproof" and "electricator" models, as well as most long-range Federal indicators.

Circle 629 on Readers' Service Card



Handwheel Designed for Machine Tools

Solid-web handwheel available in two styles and a wide range of sizes from Machine Products Corporation, Detroit, Mich. Made in straight and offset (dished) web styles in diameters ranging from 4 that give you toolroom precision plus production line speed.

Plunge grind threads long in a turn and a half or traverse grind long threads as fine as 60 pitch

And you have a choice of Crushtrue wheel dressing (or multi-rib or single-rib diamond wheel-dressers) with manual or automatic crushing. Furthermore, Crushtrue dressing is ideal for grinding intricate profiles.

Sheffield's versatile standard Thread and Form Grinders (Model 101, illustrated, capacity 7" diameter x 12" long; Model 103, 7" diameter x 24" long) are equally at home in the tool room making one of a kind precision threads, or in the production line plunge grinding thousands of threaded or profiled parts.

Wheels may be diamond dressed . . . or Crushtrue® dressed for these advantages:

Greater production: wheel is sharper, grinds cooler. Faster stock removal: no dull flats, no burning, no loading up. Faster redressing: wheel is redressed in seconds. Highly accurate: tolerances on width within .0002", radii within .002", straight sides within .003". RMS finishes as low

as 8 microinch, grooves as narrow as .020".

Standard accessories and special loading, holding, and ejection devices can be made available for specific high production jobs.

May we send you TFG 1159 catalog on models 101 and 103 and Bulletin CR 355 on the remarkable advantages of Crushtrue® grinding?



A subsidiary of The Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems . Machine Tools . Contract Mfg.



The Most for Your "Rockwell Testing" Dollar!

Clark Hardness Testers are guaranteed accurate for all "Rockwell Testing". Clark's exacting workmanship in the production of penetrators, testing blocks, anvils, and other accessories pays off in exceptional accuracy on the job. No wonder the low cost surprises our first-time customers. Clark Instrument, Inc., 10204 Ford Road, Dearborn, Mich.

FREE REFERENCE BOOK

All Information about hardness testing in easy-to-reed text with many illustrations. Just write "Send Book" on your letterhead. Description and prices for Clark Hardness Tester and free Hardness Conversion Chart also available on request.



Circle this page number on card

to 15 inches, these handwheels are primarily designed to provide an added safety factor in applications where they turn at high speeds. They may also be utilized where appearance is a consideration. Manufactured from fine-grained cast iron and cadmium-plated, these wheels are offered as castings only, or they may be purchased machined, with solid handle, revolving handle, or no handle.

Circle 630 on Readers' Service Card

Deceleration Valve with Adjustable Throttle

A 5- to 25-gpm deceleration valve for hydraulically actuated machinery which permits external adjustment of back pressure to provide the desired deceleration rate has been announced by Vickers Incorporated, Detroit, Mich., division of Sperry Rand Corporation.



To provide proper deceleration characteristics through the complete flow range, the internal port area is altered by the external adjustment. The length of the spool stroke remains constant regardless of the volume setting. Machine tool setup time is reduced because the new valve eliminates the need for special valves, spool modifications, and deceleration-cam alterations. An adjustable-needle valve permits metering oil through the valve when complete shut-off is not desired. Although rated at 5to 25-gpm nominal flow, the valve can be used for applications up to 60 gpm without malfunction. Maximum recommended operating pressure is 300 psi. This valve is available in either gasket-mounting or threaded-port designs.

Circle 631 on Readers' Service Card



Boost Pump for Test-Stand Equipment

High-speed, high-performance hydraulic boost pump announced by Double A Products Co. (a subsidiary of Brown & Sharpe Mfg. Co.), Manchester, Mich. This pump is designed to provide an instant and always-sufficient supply of fluid to high-pressure piston pumps used on missile and aircraft test stands to overcome dry starts and starvation. It is built to deliver a minimum of 31 gallons per minute at 3450 rpm, using MIL 5606 or 6083 fluids at 160 degrees F. It operates with inlet conditions ranging from 125 psi to in excess of 18 inches Hg.

Circle 632 on Readers' Service Card

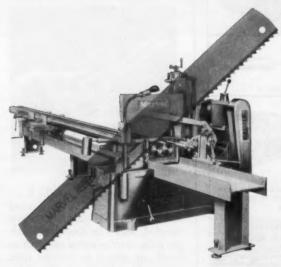
Wales-Strippit Screw Feeder

Automatic screw feeder which can be used with all makes of pneumatic and electrical tools to feed and position any type of screw fastener, announced by Wales-



a message to owners of MARVEL HACK SAW MACHINES

If you are the owner of a MARVEL Hack Saw Machine, check the name on the blades being used in it. If they are not MARVEL Blades, the chances are very good that you are not getting all the cutting-off speed, accuracy, and economy you paid for when you bought a MARVEL Saw. Consider this fact. The hack saw blade is the cutting tool that actually does the cutting job. If the machine is expected to deliver its full efficiency, the blade must possess a ruggedness comparable to that of the machine. Isn't it logical, then, that the blades you use be as carefully selected as the machine itself? Here is another fact: The MARVEL High-Speed-Edge Hack Saw Blade was designed specifically to withstand the heavy feed pressures and high cutting speeds your MARVEL Hack Saw can deliver. Only MARVEL UNBREAKABLE Hack Saw Blades can be safely tensioned taut enough to provide the maximum rigidity of the cutting tool necessary for accurate cutting-off; and at



the same time, protect both the operator from injury and the machine from damage that so frequently occurs with "breakable" blades.

Why not be certain your MARVEL saw is delivering the high performance you had originally purchased, by using the only blade capable of utilizing the power and accuracy built into the machine? MARVEL Hack Saw Machines and MARVEL High-Speed-Edge Blades are an unbeatable combination. MARVEL High-Speed-Edge Hack Saw Blades are stocked and sold by leading Industrial Distributors everywhere.



ARMSTRONG-BLUM MFG. CO. 5700 Bioomingdale Avenue • Chicago, Illinois Better Machines-Better Blades SAWS

Strippit, Inc., Akron, N. Y. Designed for vertical screwdriving operations, this "Strippit Zipp" tool eliminates manual screw placement and is set at the factory to drive specific types of screws. Featuring a minimum number of moving parts, it consists essentially of a hopper holding the screws and an elevator which picks them up and feeds them, one at a time, through a plastic tube by gravity with each driving stroke of the tool. As the screw is set under the driving blade, a collet which is



precision machined holds the screw accurately and firmly in place.

Circle 633 on Readers' Service Card

Gage for Tube Connector Port Contours

Flush-pin gage for checking the "X" tolerance of port contours of MX33514, MS33515, NAS1214, and NAS1215 flareless tube connectors, brought out by the Sonnet Tool & Mfg. Co., Hawthorne, Calif. This gage is simple, accurate, and easy to use for in-process inspection, as well as final inspection of port contours after machining. It is made of corrosion-resistant stainless steel and is available for all thirteen sizes of each specification.

Circle 634 on Readers' Service Card

"Hi-Flo" Airline Coupler

One of a line of "Hi-Flo" airline couplers designed to "make compressed air as easy to use as electricity," introduced by A. Schrader's Son, Brooklyn, N. Y. The check unit and adapter of the coupler lock together with a snap. Once closed they will not accidentally pull apart when snagged on ma-



chinery or dragged across the floor. The couplers can be connected and disconnected easily. A heavy knurled sleeve on the check unit provides nonslip action even when hands are gloved or covered with grease. In addition to this safe, positive operation, the quick-acting couplers allow more air to flow, thus increasing the efficiency of air



Earthmoving muscles from tubes of steel

A construction site springs to life as earthmoving equipment tugs, scoops, heaves and rips away at the earth's skin. It's grueling work!

That burly dozer. It's precision built! It's strong! Its massive blade can tear the side out of a hill. Yet, it's nimble, too. In spite of a crab-like figure, it can stop with a jolt, back off, spin, dig in and charge with the force of a galloping rhinoceros.





Power is jammed into these machines. That's why they're built with the toughest, most durable materials in the world. For years, leading manufacturers have chosen USS National Seamless Mechanical Steel Tubing for hydraulic cylinders, tractor pins, bushings and more than 100 other vital parts in earthmoving, rockmoving, grading and all types of heavy mobile equipment. Why? Because National Seamless Tubing is ideal for the fabrication of machine parts subject to bruising performance and long wear.

USS National Seamless Mechanical Steel Tubing is another product from the world's largest manufacturer of tubular materials. For more than 80 years, National Tube has been foremost in building and industrial pipe applications. For more information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks



National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributars United States Steel Supply Division United States Steel Export Company, New York tools and equipment. Air flow through the couplers has been raised to approximately 65 cfpm at 100 psi inlet pressure. These couplers are interchangeable with similar types used throughout industry. The coupler has only three parts in the check unit—a spring, deflator, and washer. All are replaced simply and easily in the field. Also the check unit swivels when connected to the line—which helps eliminate kinking of the hose.

Circle 635 on Readers' Service Card

Skinner Solenoid Valve

High-pressure model added to two-way Type R Series line of pilot-operated solenoid valves made by Skinner Electric Valve Division, New Britain, Conn. The new valve is offered in two-way, normally closed construction and in a wide range of voltages and frequencies with many electrical options. Orifice size is 1/4 inch in diameter with 1/4-inch NPTF ports. Operating pressure differentials are 5 to 1250 psi on alternating-

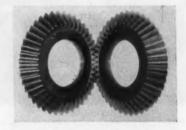


current voltage and 5 to 1000 psi on direct-current voltage. Higher than standard pressure ratings are available for specific application. The valves are designed for use with air, oil, water, and other common media.

Circle 636 on Readers' Service Card

Spheroid Bevel Gears with New Tooth Design

Standard design "FMS" spheroid bevel gears for use in all types of bevel-gear applications announced by the Braun Gear Co., Brooklyn, N. Y. Said to be a new concept of straight bevel-gear tooth design, these multiple-contact, fullfillet bevel gears, with a minimum of two teeth in contact at all times, provide for increased load capac-



ity and smooth, quiet operation. The regular standard series "A." for use in all ordinary industrial applications, is machined after heattreatment and affords a capacity similar to the commercial standard for spiral bevel gears. Series "AA," providing a 50 per cent higher load capacity than Series "A," is casehardened, with the teeth silverplated for positive lubrication during the normal break-in period. The most commonly used ratios and sizes of Braun "FMS" spheroid bevel gears are available from stock, in standard ratios of 1 to 1, 2 to 1, 3 to 1, 3 to 2, and 4 to 3, with available pitch diameters from 1 inch to 13 1/2 inches.

Circle 637 on Readers' Service Card



Another advantage of the Seneca Falls Model Q Lathe is its strikingly practical design which recognizes the user's problems. Production turning machines produce chips. Chips can be an awful pain. So we put the template and stylus where chips can't interfere with the amazing accuracy built into Model Q. Likewise you will find efficient chip guarding, adequate chip flow area, and practical chip disposal means are other features of this unusual lathe.

Write for Bulletin Q-59 for the full story.

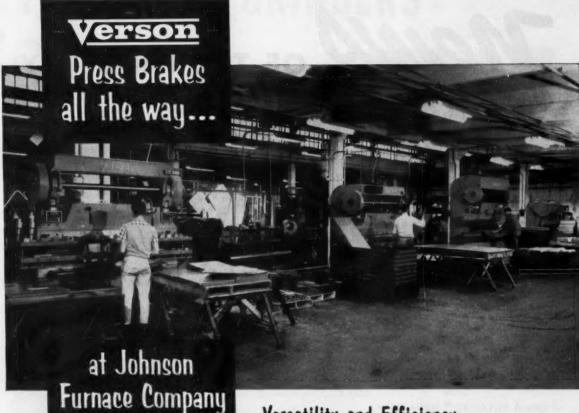


- "Dial Your Set-up System" simplifies changeover.
- Multiple tools rough and tracer tools finish turn in one automatic cycle.
- Mechanical feed to all carriages.
- · Templates clear of chip area.
- · Easy to load and unload.
- Straight line diameter adjustment for tracer tools.
- Four speed headstock available with automatic speed change.
- Feed rate can change during cutting cycle.



DO tell us your troubles. If turning, centering or automation are involved, most likely we can do more than sympathize

SENECA FALLS, MACHINE CO. SENECA FALLS, N. Y.



Versatility and Efficiency Add Up to Profitable Production

Press brake operations on Air Ease Furnaces at Johnson Furnace Company, Cleveland, Ohio, are performed in the versatile, efficient machines shown above. The line is 100% Verson.

By using Verson Junior and Intermediate Brakes exclusively, Johnson takes maximum advantage of the unique combination of economy and "big machine performance" that these brakes offer. Just take a look at the jobs being done (from left to right):

- Verson No. 2062 Brake performing dimpling on the top door panel. A gang punch die set accommodates dimpling tools. All in-line piercing operations are also done in this machine.
- 2. Verson No. 2062-F Brake makes six 90° bends in the furnace base in one handling of the sheet.
- 3. Verson No. 206-F Brake makes two offset bends at sides of notched sheet that is subsequently formed into a box shaped outer radiator shell on the horn type bed and ram extensions. The machine is equipped with double stop and inching control.
- Verson No. 1062 Brake with a two hit rocker seam die and a two hit plain seam die used on the furnace top front panel.

Find out how Verson Press Brakes can help make your production more efficient and more profitable. Just ask to have a Verson Sales Engineer go over your needs with you. Write, wire or phone, today.

Typical Johnson Air Ease Furnace on which all press brake operations are performed in Verson Press Brakes.

Originators and pioneers of allsteel stamping press construction

w Verson w

VERSON ALLSTEEL PRESS CO

9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES

TRANSMAT PRESSES • IMPACT MACHINING PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS

Mews of the industry

California and Washington

HUGHES AIRCRAFT Co., Culver City, Calif., announces that LESTER V. S. Sanson has been appointed manager of the manufacturing and parts service division of the company's Ground Systems Group, Fullerton, Calif. ROBERT M. SNYDER has been named manager of the radar systems department of the radar laboratory at the Group, Jon H. MYER has been appointed manager of the newly created materials development and supply laboratory of the company's Semiconductor Division at Newport Beach, Calif. The new lab will develop and supply new semiconductor materials to be used in the production of subminiature diodes. transistors, and rectifiers. Mr. Myer has been head of the technical services department.

AMPCO METAL, INC., Milwaukee, Wis., has purchased the former A. O. Smith foundry at Huntington Park, Calif. The foundry site will become the center of expanding West Coast activities for the firm about August 1, 1960. Ampco's present plant at Burbank, Calif., will be sold in connection with the transfer.

REMCO MFG. Co., Willits, Calif., announces the purchase of the complete cylinder line of the TURLOCK IRON & MACHINE WORKS. All of the production machinery and employes and management have been moved to the Remco plant in Willits, Calif.

CHEM-MILL DIVISION of Turco Products, Inc., Wilmington, Calif., announces that it has concluded license negotiations and has executed a Chem-Mill Process License Agreement with United Aircraft Corporation and Aerojet-General Corporation.

WESTERN GEAR CORPORATION, Lynwood, Calif., announces that Charles C. Harshberger, formerly Portland district sales manager, has been transferred to its Seattle district headquarters. Fred Hearing, formerly sales engineer in the Seattle office, has been transferred to Portland and promoted to sales manager for that district, replacing Mr. Harshberger, who will serve the Seattle district area as sales manager.

O. J. HARPER SALES Co., Renton, Wash., has been named Pacific Northwest sales agent for the KAY-LOCK DIVISION of Kaynar Mfg. Co., Inc., Los Angeles, Calif.

Illinois and Indiana

NATIONAL METAL TRADES ASSOCIATION, Chicago, Ill., announces that JOHN A. BRADNER and JOHN J. HALL have been named vice-presidents of the association, composed of more than 1500 firms in the metal trades and other industries. Mr. Bradner is president of the Lees-Bradner Co., Cleveland, and Mr. Hall, industrial relations director of Brown & Sharpe Mfg. Co., Providence, R. I.

STUART A. SMITH has been appointed general sales manager of the TOOL AND INSTRUMENT DIVISION, Illinois Tool Works, Chicago, Ill.



Don Greenberg, chief engineer, Barnes Drill Co.

Don Greenberg has been named chief engineer of Barnes Drill Co., Rockford, Ill. Mr. Greenberg started in the Engineering Department of the company in October, 1947, and he has most recently been a sales engineer in the Honing Department.

PETER REBECHINI has been named chief engineer of THOR POWER TOOL. Co.'s Aurora Works, Aurora, Ill. Mr. Rebechini joined Thor in 1943 as a junior electrical engineer and became director of the Thor engineering lab-



Peter Rebechini, chief engineer, Thor Power Tool Co.

oratory in 1946, a position he held until being named chief electric tool engineer in February, 1958.

ROBERT W. BEART has been elected vice-president of patents and development of ILLINOIS TOOL. Works, Chicago, Ill. He was director of the Patent Department and will direct the patent program.

Besly-Welles Corporation, South Beloit, Ill., announces the opening of a new combination warehouse and branch office at 1025 Greeley Ave., Union, N. J.

Unimet Carbides, Chicago, Ill., has recently appointed the following distributors: A. W. Davis Co., 2351 N. W. York St., Portland 1, Ore.; Eastex Welding Supply Co., 1232 Gladewater Road, Longview, Tex.; J & L Tool Sales, 19164 Woodward Ave., Detroit 3, Mich.; C. S. Kegerreis Supply, Inc., 510-516 S. 2nd St., Elkhart, Ind.; Joseph E. Loughhead Co., 326 W. Kalamazoo Ave., Kalamazoo, Mich.

PRECISION GRINDERS



PRECISION + VERSATILITY + EASY OPERATION =GREATER GRINDING EFFICIENCY

Models 1300, 1305 and 1310 are precision grinders that offer unusual versatility and ease of operation. They assure high grinding efficiency on such operations as: external cylindrical or taper, internal, and cutter or tool grinding. Of simple, accurate and rugged design, these grinders are available in three capacities: 8" swing and 18" between centers; 10" x 27"; and 10" x 40".

FEATURES:

JONES-SHIPMAN

- · Roundness to .00001"
- · Surface finish to 1 micro-inch
- Parallel grinding to within .00025" in the center over 24".
- · Shockless table reversal at all speeds.
- Table reversal accuracies: .0005" for models 1300 and 1310, and .001" for model 1305, at maximum table speeds.
- Micrometer movements on table and cross traverse.
- · Trouble-free, low-pressure hydraulic system.
- · Nitralloy wheel spindle running in plain bearings.
- Super-accurate workhead spindle in selected plain bearings.
- Minimum stroke of .020" at maximum table speed.

SEVERAL types of wheelheads of proven design are available. Also, special attachments to efficiently meet any grinding requirement can be furnished.

FOR FURTHER INFORMATION, WRITE FOR YOUR COPY OF BULLETIN 208M



MICROMATIC HONE CORP.

Cosmo Wheels, Inc., a new national marketing organization, is establishing an office and warehouse at 1019 W. Fulton St., Chicago, Ill. The new organization will maintain complete sales, service, and warehouse facilities for national distribution of standard contact wheels and other products manufactured by Chicago Rubber Co., Inc., Waukegan, Ill.

NEFF, KOHLBUSCH & BISSELL, INC., Chicago, Ill., announce that their firm has been appointed sales and service representatives for the FedERAL MACHINE & WELDER Co., Warren, Ohio, line of "WARCO" mechanical presses. The newly appointed representatives cover the Chicago and north central Illinois area, northwest Indiana, and Iowa.

DONALD NEWELL has been promoted to tool and methods engineer for WALES STRIPPIT, INC., Akron, N. Y. Mr. Newell will be assigned to cover Chicago and outlying districts south of that city.

ADOLPHE S. KROMER has been elected president and general man-

ager of FLEXONICS CORPORATION, a subsidiary of Calumet & Hecla, Inc., Chicago, Ill. In his new position at Flexonics, Mr. Kromer will be responsible for all operations of the newly acquired Corporation.



R. Johnson, new vice-president and general sales manager, Dreis & Krump Mfg. Co.

R. JOHNSON has been appointed vice-president and general sales manager of DREIS & KRUMP MFG. Co., Chicago, Ill. Mr. Johnson has been with Dreis & Krump eight years, and was formerly sales manager of the Tooling Division.

HAROLD H. DICE, general manager of the Allison Division, Indianapolis, Ind., was elected a vice-president of General Motors Corporation. Mr. Dice became general manager of Allison on March 1. A veteran of more than thirty years' service with GM, he had served as assistant general manager at Allison for seven years.

Michigan

CLARK EQUIPMENT Co.'s Industrial Truck Division, Battle Creek, Mich., has made two appointments. Leighton E. Campbell has been named general service manager. J. M. Squier has been made manager of service engineering. Mr. Campbell will have headquarters at Clark's Central Parts Division in Chicago and Mr. Squier will have his office in Battle Creek.

METALLURGICAL PRODUCTS DE-PARTMENT, General Electric Co., Detroit, Mich., announces that Dr. R. W. Guard has been appointed manager—product and process devel-



STANDARD EQUIPMENT

Air clutch. Air-release, spring-set brake. J.I.C. wiring and controls. Solenoid—controlled dual air valves. Adjustable gibs with bronze or composition faced ways on slide. Hard bronze crankshaft bearings. One-shot forced lubrication. Optional equipment as required.

- Completely new design in geared and non-geared types incorporates proven construction features.
- Exceptional rigidity insures long die life and close product tolerances..
- Large box-type slide mounted in long gibs holds accurate alignment.
- 125 ton capacity covers wide variety of jobs.
- Big die capacity—bolster area 29" x 42"—shut height 18", or to suit.
- Versatile efficient dependable.

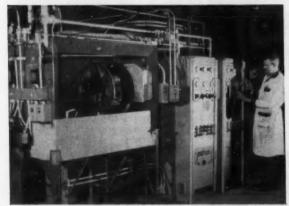


WRITE for complete information on this new press. Also, 14 to 150 ton O.B.I. presses, 20 to 150 ton straight side presses, 30 to 75 ton gap frame presses.

L&J PRESS CORPORATION 1631 STERLING AVE.

Flame sprayed metal increases wear resistance better than 10 times

AIDS WEIGHT REDUCTION



Automatic setup for metallizing inner walls of aluminum cylinders used in lightweight gasoline engines. Cabinet in foreground houses six-station rotary setup; automatic control panels are at right.

Many methods, including cast-iron cylinder liners and chrome plating, have been tested for wear resistance in lightweight gasoline engine blocks of aluminum.

Best of these methods experienced breakdowns in less than 400 hours. Now they are metallized with METCO Sprabond (molybdenum alloy) as a bonding agent, followed by a coating of sprayed steel alloy.

Test runs of over 4,000 hours show little or no wear of the metallized surface. Finish thickness is .007"; weight – a few grams. Cast-iron liners weighed almost ½ pound.

Cylinder at left machined ready for flame spraying; one at right has been metallized and hone finished.







Closeup of automatic six-station rotary setup. Cylinders are individually rotated at 150 rpm. Cylinder is loaded on table at Station 1, moved through Stations 2 and 3 for pre-heating by torch. At Station 4, bonding coat is applied by the gun nozzle which feeds into the rotating cylinder. Low alloy steel is applied at Station 5 and cylinder cools at Station 6. Cylinder walls are finished by honing.

New engineering data bulletin

Bulletin 136B—The Metco Flame Spraying Processes, provides basic engineering and application data on flame sprayed coatings of metals, ceramics, carbides and other high melting point materials. 16 pages. Send coupon for free copy.

Metallizing Engineering Co., Inc.



Flame Spray Equipment and Supplies
1131 Prospect Ave., Westbury, L. I., N. Y.
Telephone: Edgewood 4-1300 Cable: METCO
In Great Britain: METALLIZING EQUIPMENT CO., Ltd.

6 Chobham-near-Woking, England

Please send Bulletin 1:	36B.
name	title
company	
address	/ 12 mg 1 3 6 3
city	zone state

opment engineering, Diamond Products Section. George Hemmeter has been appointed manager of manufacturing, Specialty Alloys Section.

CHRYSLER CORPORATION, Detroit, Mich., announces the appointment of JOHN B. KENDALL as manager of the corporation's Conant stamping plant. Mr. Kendall succeeds W. R. GERBER, who is joining the staff of the general plants manager for the Stamping Division.

S. PAUL BURNS, for the past five years vice-president and chief engi-

neer of PIONEER ENGINEERING & MFG. Co., INC., Detroit, Mich., has been named executive vice-president and elected to the board of directors of that organization.

ROBERT F. LUTZ has been appointed factory manager of Bosworth Steel Treating Corporation, Detroit, Mich.

THE CROSS Co., Detroit, Mich., announces the appointment of WALTER R. OPEL as chief engineer. He will supervise the design teams creating special-purpose machine tools.



George H. Whitehouse, member of the board of directors, Snyder Corporation

George H. Whitehouse, vicepresident of sales of Snyder Corporation, Detroit, Mich., has retired after twenty-nine years of service to the company. Mr. Whitehouse will continue as a member of the board of directors and serve in a consulting capacity to the company. He has had a varied career in the industry.

New England

CHARLES B. EISENHAUER has been named general manager of the Electronics Division of Van Norman Industries, Inc., New Bedford, Mass. Mr. Eisenhauer is responsible for formulation and administration of all policies affecting plant operation of the Electronics Division, including government contracts, engineering, purchasing, manufacturing, quality



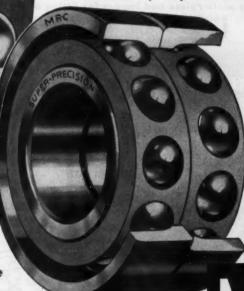
Charles B. Eisenhauer, riew general manager, Electronics Division, Van Norman Industries, Inc.





IN Super-Precision BALL BEARINGS

MRC Super-Precision Ball Bearings are used in all types of critical applications ranging from miniature sizes, for guidance systems in missiles, to extra-large bearings in massive machine tools. These bearings provide maximum capacity and extreme accuracy.



Backed by 62 Years Experience

Consult OUR Engineering Department on YOUR Bearing Problems

MARLIN-ROCKWELL CORPORATION
JAMESTOWN, NEW YORK

BALL AND ROLLER bearings

control, industrial relations, and development of budget controls.

Frank G. Gustafson has been appointed supervisor of the process engineering department in Plant 7 at Norton Co., Worcester, Mass. He has worked for the company in many capacities.

WILLIAM E. MATTHEWS has joined the S. W. CARD DIVISION of the Union Twist Drill Co., Mansfield, Mass., as a field engineer covering eastern Pennsylvania, Delaware, and Maryland. He has broad practical knowledge of manufacturing methods and plant operations.

JAMES N. HEALD II has been appointed to the newly created position of manager of domestic distributor sales for the HEALD MACHINE Co., Worcester, Mass. Mr. Heald has served in the Heald Detroit sales office and with distributor sales areas in the West and Midwest. More recently he has been responsible for numerical-control applications and installations involving Heald equipment. Mr. Heald will have his office in the company's Worcester head-



James N. Heald II, manager of domestic distributor sales, Heald Machine Co.

quarters. He has been with the company eight years.

RICHARD M. STEWART, president of the American Brass Co., Waterbury, Conn., has been elected to the board of directors of MACDERMID INCORPORATED. Mr. Stewart has been named by MacDermid directors to fill the vacancy left by the retirement of ARCHIE MACDERMID, founder of the Waterbury firm. Mr. Stewart holds several advisory posts in the state government, including a position in Governor Ribicoff's Economic Cabinet of the Connecticut State Development Commission.

DANIEL C. McCarthy has been named administrative vice-president of Pratt & Whitney Co., Inc., West Hartford, Conn. Mr. McCarthy comes to Pratt & Whitney after extensive experience with such con-

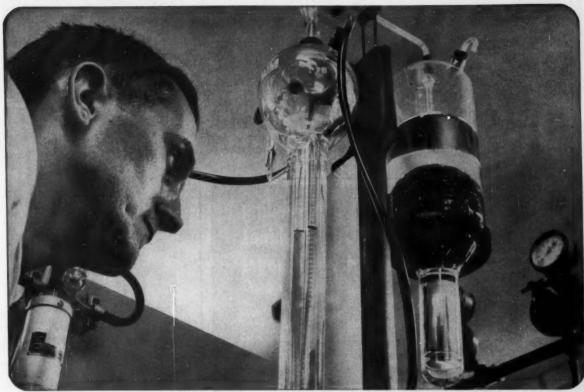


Daniel C. McCarthy, newly appointed administrative vice-president, Pratt & Whitney Co., Inc.



THE HAMILTON TOOL COMPANY \cdot 834 SOUTH NINTH ST. HAMILTON \cdot OHIO \cdot U. S. A.

Experience—the added alloy in Allegheny Ludium tool steels



QUICK, FAST TESTING for carbon content is done not once or twice but 8 times per melt in A-L's Chem Lab with this direct reading Leco carbon determinator.

Carbon content checked 8 times during melt to guarantee A-L tool steel hardenability

Lab tests for carbon eliminate your guesswork; provide high hardness, uniform hardenability, reproducible tool performance.

Because carbon has the greatest influence on hardenability, Allegheny Ludlum watches it carefully during the melt. Testing a specimen for carbon takes only a few minutes. Therefore, A-L checks for carbon content 8 times during the melt, and makes the necessary adjustments to insure accurate control of carbon. This control means Allegheny Ludlum can hold carbon content to a closer range than most customers specify.

Carbon control at Allegheny Ludlum assures you of precise response to heat treating. This control in the melt brings you predictable, high hardness, uniform hardenability and reproducible tool performance.

This is just one of the many things A-L does to insure

high quality. Here are some others: close control over forging techniques, rigid temperature-time programming, careful testing of billets prior to processing to insure good surface and sound interior, control over annealing to give you the right hardness for your exact machining operation, thorough metallurgical testing to insure top tool steel quality and meeting of your specifications.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh 22, Pa. Address Dept. M-5

7261

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country...Check the yellow pages every grade of tool steel...every help in using it



cerns as Mobile Oil Co., Ford Motor Co., and Chrysler Corporation.

JAMES A. CARTER has been appointed general plant superintendent of PITNEY-BOWES, INC., Stamford, Conn. Mr. Carter will be responsible for all machining, finishing, and assembly operations for an expanding product line.

Nelco Tool Co., Manchester, Conn., a subsidiary of the Cutting Tool Division, Brown & Sharpe Mfg. Co., is expanding the manufacturing facilities of its plant. The new building addition will be finished in early April.

New York and New Jersey

JAMES M. DILL has been appointed to the newly created position of special products sales manager for RUSSELL, BURDSALL & WARD BOLT AND NUT CO., Port Chester, N. Y. Mr. Dill will be concerned with sales management and promotion of such R B & W products as stainless steel,

aluminum, brass, silicon bronze, Delrin and nylon, as well as proprietary products such as Tensilock and Spinlock fasteners. His duties will include evaluation of market potentials, development of specifications, establishment of production points and stock levels, sizes and types, pricing, and sales promotion.



Edwin R. Smith, Jr., newly elected president and treasurer, Seneca Falls Machine Co.

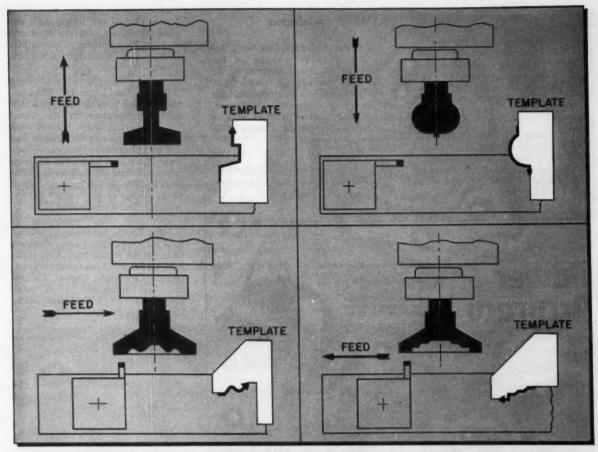
SENECA FALLS MACHINE Co., Seneca Falls, N. Y., announces that Edwin R. Smith, Sr., president, treasurer, and director of the company for forty years, has announced his retirement. Edwin R. Smith, Jr., has been elected president and treasurer. Mr. Smith has served as executive vice-president and director of the firm for a number of years. The appointment of Daniel V. McNamer, Jr., president of First Albany Corporation, Albany, N. Y., as chairman of the board of directors was also announced.

GARRETT CORPORATION, Los Angeles, Calif., announces that RAY-MOND J. NIEMELA has been appointed manager of the Mineola (N. Y.) branch office of the Airsupply-Aero Engineering Co., a division of the corporation.

Ferracute Machine Co., Bridgeton, N. J., announces the appointment of two new distributors. In the state of Missouri and the southern part of Illinois, the complete Ferracute line will be represented by Continental Machinery Sales Co., 2120 S. 7th St., St. Louis 4, Mo. The entire state of Oklahoma will be covered by Industrial Machine & Tool. Co., 615 N. Sheridan Road, Tulsa, Okla.

(This section continued on page 268)





ALL FOUR of these Automatic Tracing Cycles are available with a SINGLE Jones & Lamson Turret Lathe

How's this for machine flexibility in one chucking? (1) You get all of the accuracy and tooling combinations offered by the standard J & L Turret Lathe. (2) You have more than 180° of tool travel control in each of four different automatic tracing cycles (you don't have to have all four, incidentally). (3) You do both rough and finish tracing (with rough and finish tools) in the same set-up. (4) You multiple-tool your tracing operations through 180° of tool control. (5) You have complete control for diameter with the conventional graduated hand wheel on either mechanical or tracing operations. (6) The original full swing of the Turret Lathe is retained with this tracer. (7) A single lever disconnects the tracer for standard turret lathe operation.

the man who needs a new machine tool is already paying for it

Such flexibility enables you to perform an amazing amount and variety of work with this new Two-Dimensional Tracer on J & L Saddle Type Turret Lathes.

It all adds up to: MAXIMUM WORK COMPLETED IN ONE CHUCKING; REDUCED HANDLING TIME: INCREASED ACCURACY. Write for further information.



JONES & LAMSON Machine Company . Dept. 710, 512 Clinton St., Springfield, Vt.

Automatic Lathes · Tape Controlled Machines · Thread & Form Grinders · Optical Comparators · Thread Tools

NORMAN FISCHELL has been appointed vice-president in charge of production by the CIRCO EQUIPMENT Co., Clark, N. J. His primary responsibility will be the direction of engineering, design, development, and diversification activities, as well as production, production control, and inventory control.

The Parker-Hannifin Corporation field sales office at Hackensack, N. J., has moved to new, larger quarters at 19 Railroad Ave., Emerson, N. J. H. A. Ludlam is district manager of distributor sales in the area.

Ohio and Alabama

George Rienerth has been appointed products manager of the Electric Controls Division of the National Acme Co., Cleveland, Ohio. Mr. Rienerth will be responsible for engineering, product development, and production of new as well as standard items in the division's line of electric controls.

HILL ACME Co., Cleveland, Ohio, has created a new material-handling division producing a line of "C"

hooks, vertical coil tongs, sheet and plate lifters, etc., for the steel and metalworking industry. HOMER MC-DANIEL is sales manager of the new division.

ARCAIR Co., Lancaster, Ohio, announces that WILLIAM BAJARI is now field representative for the Arcair Co., Bremerton, Wash. He will work with the company's distributors and call on industries in thirteen western states. RICHARD HENDERSON has been appointed chief engineer for the company in Ohio. In this capacity he will be in charge of all product design, research, and development.

JOHN KRAUS has been appointed field sales representative in southern Ohio for the ALLEN MFG. Co., Hartford, Conn. Mr. Kraus's territory will include Cincinnati, Dayton, Columbus, and Springfield, Ohio, with headquarters at 2515 Mercury Ave., Cincinnati 3, Ohio.

STAINLESS PROCESSING DIVISION of Wall Colmonoy Corporation, Detroit, Mich., has opened a new plant for stainless alloy brazing and furnace heat processing at 5221 Webster St., Dayton, Ohio. Manager of the new plant is Dale Finnock.

ELECTRIC AUTOLITE Co., Toledo, Ohio, has formed a new Special Products and Research and Development Division (SPARD). Heading this division will be Autolite director of research, George E. Spaulding, who has been with the firm since 1948. He was named director of research in 1957. Work under his direction since that time has included development of transistorized ignition, transistorized instruments and controls, hydraulic devices and a



George E. Spaulding, director of research, Electric Autolite Co.



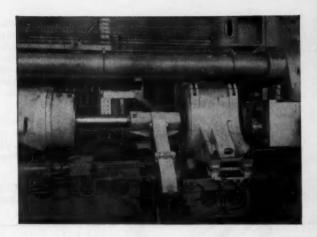
Write for bulletin and sample accuracy test sheet.

SHELDON MACHINE CO., INC.

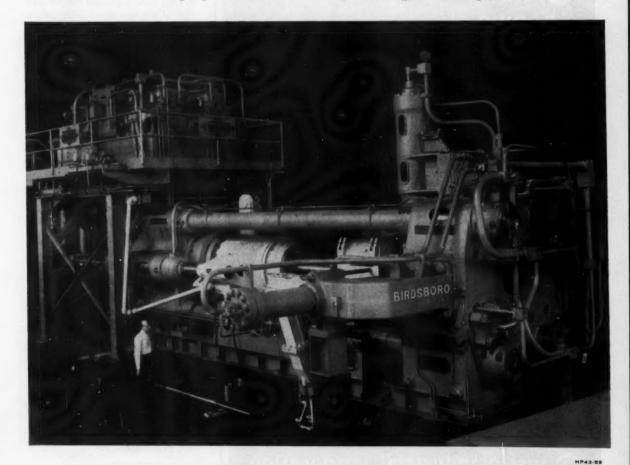
4246 KNOX AVE., CHICAGO, ILL.

Latest BIRDSBORO Press cuts costly extrusion dead cycle time for Revere

• This 3000-ton oil hydraulic mandrel mover extrusion press, now in use by Revere Copper and Brass, is of the latest modern BIRDSBORO design. Extremely fast acting, it operates with a minimized dead cycle time. BIRDSBORO'S approach to proper component and circuit design results in rapid, fully integrated operation with maximum use of the press in actual extrusion of aluminum and aluminum alloys, including the high strength copper bearing varieties. Detailed descriptions of this and other advanced design hydraulic extrusion



presses are available through your BIRDSBORO representative. Sales Department: Reading, Pa., Engineering Department and Mfg. Plant: Birdsboro, Pa., District Office: Pittsburgh, Pa.





BIRDSBORO

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel.

MACHINERY, May, 1960

For more data circle this page number on card at back of book

269

number of co-development programs with the company's ceramic, electrical products, and plastics engineering staffs.

PAUL G. GAFFNEY has been appointed east central district sales representative for Carboloy cutting tools for the METALLURGICAL PROD-UCTS DEPARTMENT, General Electric Co., Detroit, Mich. Mr. Gaffney will work out of Dayton, Ohio.

ABBEY ETNA MACHINE Co., Perrysburg, Ohio, has established a new Cleveland district branch office at 869 Richmar Drive, Westlake, Ohio. J. E. (JACK) DILL will head the branch for the sales and service of Abbey Etna products for the entire area including eastern Ohio, western Pennsylvania, western New York State, and Canada.

ALLAN S. WHITE has been appointed a field engineer for the Cleveland, Ohio, district of NORTON Co., Worcester, Mass.

STANLEY E. CASSON, director of sales of the NATIONAL ACME Co.,

Cleveland, Ohio, was elected vicepresident-sales.

C. R. BRADLEE was appointed manager of cold-forming sales for the E. W. BLISS Co. Press Division, Canton, Ohio.

AIR REDUCTION SALES Co., New York City, announces the dedication of the company's newest liquid-air separation plant in Fairfield, Ala. The new plant will produce over 30 tons of liquid oxygen, nitrogen, and argon per day. The Fairfield facility is one of two additional air-separation plants at that site. The other, which will be completed in the fall of 1960, will supply tonnage oxygen by pipeline to the Tennessee Coal & Iron Division of the United States Steel Corporation.

AIR REDUCTION SALES Co., New York City, announces that J. S. STEV-ENS has been appointed district manager of the company's Birmingham, Ala., office, at 124 South 16th St., that city. Mr. Stevens succeeds J. M. CROCKETT, who has been transferred to Airco's head office in New York.

Pennsylvania

LAWRENCE M. THOMPSON has joined MANHEIM MFG. & BELTING Co., Manheim, Pa., as director of engineering. He will be in charge of quality control of all company prodnets.

DR. LAWRENCE R. SCHARFSTEIN has been appointed supervisor, corrosion research, by the CARPENTER STEEL Co., Reading, Pa. In his new position, Dr. Scharfstein heads a corrosion research group for developing new methods to obtain accurate corrosion data for Carpenter alloys.

KENNETH H. CARLSON has been appointed manager, technical services of FIRTH STERLING, INC., Pittsburgh, Pa. Mr. Carlson will serve as technical and metallurgical adviser to users of Firth Sterling high-purity metals.

HENRY FOSTER DEVER, vice-president of Minneapolis-Honeywell Regulator Co., in charge of its Industrial Products Group, has been elected a director of F. J. STOKES CORPORA-TION, Philadelphia, Pa.

Wisconsin

ALLIS-CHALMERS MFG. Co., Milwaukee, Wis., announced that it has combined its Industrial and General





B&W Job-Matched Lectrosonic hydraulic line tubing

B&W offers you:

- an electric-resistance-welded carbon steel hydraulic line tube manufactured to JIC standards under a rigid system of quality control
- a full range of tube sizes to match your hydraulic application requirements
- a hydraulic line tube that costs far less than seamless in comparable sizes

B&W Job-Matched LECTROSONIC Hydraulic Line Tubing is available through a nationwide network of district sales offices and steel service centers. And remember — matching tubes to jobs assures you the right tube, in the right quantity, at the right time. For more information, call your local B&W District Sales Office, or write for Bulletin T-435. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.



THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

Products Divisions into a new operating unit called the Industrial Equipment Division, with W. M. WALLACE, a vice-president and general manager of the new division. G. A. SAAR was appointed assistant general manager. The new division includes the Compressor, Processing Machinery, Centrifugal Pump, Control, and the Industrial Systems departments, in addition to the Norwood Works motor and pump manufacturing facility. Canadian Allis-Chalmers, formerly a part of the Industrial Equipment Division, will

now operate as a separate division of the Industries Group. H. M. SCHUDT, president of Canadian Allis-Chalmers, is divisional general manager.

France

CONE AUTOMATIC MACHINE Co., INC., Windsor, Vt. (U. S. A.), and Régie Nationale des Usines Renault of Billancourt, France, have concluded an agreement under the terms of which the latter firm will be licensed to build in its factories the 1-inch, six-spindle "Ts Conomatic" ad-

justable camming lathes. The Régie Nationale des Usines Renault has granted to Forges de Vulcain of Paris, France, the rights to sell these machines in France and in the French Commonwealth.

Coming Events

MAY 9-13—Southwestern Metal Exposition will be held at State Fair Park, Dallas, Tex. For further information inquire of Chester L. Wells, exposition manager, the American Society for Metals, Metals Park, Novelty, Ohio.

MAY 17-19—ASME Production Engineering Conference will be held at the Schroeder Hotel, Milwaukee, Wis. For additional information: L. S. Denegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

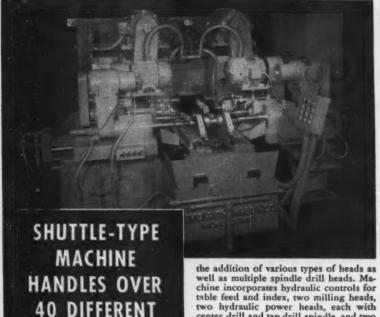
MAY 23-26—Design Engineering Show and Conference sponsored by American Society of Mechanical Engineers, to be held at New York Coliseum, New York City. For further information, write to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

JUNE 5-9—Summer Annual Meeting and Aviation Conference of the American Society of Mechanical Engineers to be held at Statler-Hilton Hotel, Dallas, Tex. For further information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

SEPTEMBER 6-16—Machine Tool Exposition, sponsored by the National Machine Tool Builders Association, to be held at International Amphitheatre, Chicago, Ill. For more information: Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

SEPTEMBER 6-16—Production Engineering Show, to be held at Navy Pier, Chicago, Ill. For additional information, inquire of Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

NOVEMBER 14-18—Third Western Tool Show sponsored by the American Society of Tool Engineers, to be held at the Memorial Sports Arena in Los Angeles, Calif. For additional information write Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.



... Mills, Centers, Tap Drills and Taps in #316 Stainless

VALVE PARTS

Here's a good example of engineering a semi-standard machine to handle a lot of parts. Although this machine has been adapted to milling, centering, drilling and tapping of valve parts, its basic design lends itself to other operations through the addition of various types of heads as well as multiple spindle drill heads. Machine incorporates hydraulic controls for table feed and index, two milling heads, two hydraulic power heads, each with center drill and tap drill spindle, and two mechanical screw feed tapping heads to accommodate 16, 20 and 24 pitch threads. Capacities range from %" to 4½" diameter, 5" to 23" long. Parts are inner valves for liquid level controls of tough #316 stainless steel.

If you need high production of one part or moderate production of many parts with a minimum capital outlay, it will pay you to call in a D & T production engineer. There is no obligation for this service.

FREE DATA ...

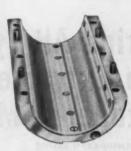


Novel Design
provides
Astonishing
Bearing Life
Bearing

The life of the HILL front spindle bearing on HILL horizontal spindle hydraulic surface grinders is truly astonishing. This bearing has been an exclusive HILL feature for more than 15 years. The necessity of replacement, under constant use, is practically unknown.







The front spindle bearing on HILL horizontal spindle hydraulic surface grinders was engineered by the HILL ACME COMPANY and has proven in the field to operate indefinitely. An alloy bronze bushing is fastened to a semi-steel casting with brass screws. The bronze bushing is undercut lengthwise in four equidistant locations on the outside diameter to allow for spindle expansion. (Darker areas in photo show undercut sections.) A perfect bearing surface is established in the I.D. of the bronze directly opposite the undercut sections. Oil is forced into specially designed concave

relief areas which act as oil wedges assuring long bearing life. Hardened dowel pins guide the two halves together to their original position. The bottom half of the bearing has an oil return slot shown at the edge of the half section on the outside diameter. Note that there are NO oil grooves in this bottom half or in the quarter half of the top section. The shaft rotation spreads the oil film from the oil distribution grooves to the perfect bearing surfaces. Any additional oil grooves would act as scrapers and be detrimental to the oil film formed around the spindle.

This is just one of the many exclusive construction features that result in the longer life and permanent accuracy of HILL heavy duty surface grinders. Detailed literature on these high-precision machine tools is now available.



24" x 24" x 72" HILL borizontal spindle surface grinder grinding blanking dies to extremely close tolerances. Also built in Vertical Spindle design,

THE HILL ACME COMPANY

HILL DIVISION . . .

ESTABLISHED 1882

1201 West 65th Street

Cleveland 2, Ohio



"HILL" GRINDING & POLISHING MACHINES

• HYDRAULIC SURFACE GRINDERS • ALSO
MANUFACTURERS OF "MCME" FORGING •
THREADING • TAPPING MACHINES • "CANTON" "ALLIGATOR SHEARS • BILLET SHEARS
• "CLEVELAND" KNIVES • SHEAR BLADES

New Books and Publications

QUALITY CONTROL. Fourth Edition. By Norbert L. Enrick. 216 pages; 43 illustrations; indexed; 6 by 9 inches; cloth. Published by The Industrial Press, 93 Worth St., New York 13, N. Y. Price, \$5.50.

This enlarged fourth edition continues in the tradition of earlier editions to present quality-control procedures which are based upon scientific principles but have been simplified for practical application in various types of manufacturing plants. The author uses carefully selected illustrative examples, to show the reader how to apply the principles involved to his own problems. By use of tabular data, the need for calculations has been greatly minimized. Most of the illustrations and case histories come from the author's consulting work

in metalworking, electronics, as well as chemical, food, and textile processing in the past fifteen years.

In the present edition, two new chapters have been added on the use of simple statistical evaluation of tolerances as an aid in establishing and maintaining realistic specifications. The new material shows how to evaluate the over-all effect of simple linear tolerance combinations, clearance and interference fit combinations, nondimensional tolerance accumulation, tolerances for individual components, and other special tolerance problems.

The material on process investigation has been enlarged with a new chapter. This new technique of "Process Optimization through Evolutionary Operation" can be used to investigate, evaluate, and improve an operating process while it is in

actual operation.

This new edition of "Quality Control" should be particularly valuable to those who determine tolerance specifications for individual components and complete assemblies in the metalworking industries. The following is a list of chapter titles: Fundamentals of Inspection, Procedure in Installing Lot-by-Lot Inspection, Sampling Continuous Products, Installing Process Inspection, Special Control Charts for Use When Equipment is Old and Worn, Applying Quality Control in the Plant, Tolerances and Allowances in Interchangeable Manufacture, Mass Production Gaging, Use of Inspection Data in Establishing Specifications, Management Aspects of Quality Control, A Typical Case History, Statistical Basis of Modern Quality Control, Mathematical Theory of Control Charts, Further Discussion of Product Variability, Control Charts Computed from Center Lines, Acceptance Control Charts, Control Charts for Percent Defective Product, Analysis of Variance, Statistical Tolerancing, Additional Applications of Statistical Tolerancing, Optimiz-ing Processing through Evolutionary Operation, and Common Interchangeable Terms.

Precision Valley. By Wayne G. Broehl, Jr. 6 by 9 inches; illustrated; 274 pages. Published by Prentice-Hall, Inc., Englewood Cliffs, N. J. Price, \$5.95.

Little formal research has been done on the machine tool industry, though its influence on the American business community has been far-reaching. This book, the first full-length business study ever made of any individual machine-tool company or companies, will help fill this

Grind All Types of Profiles To Extreme Accuracy with Studer PSM's

PANTOGRAPH RATIOS

PSM 250 1:1-10:1 PSM 130 1:1-100:1

APPLICATIONS

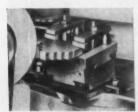
(With Automatic Grinding Wheel Feed)

- Grinding of flat form tools
- Grinding of circular form tools
- Grinding of sectional dies
- Taper relief grinding
- Grinding of crushers or rolls between centers
- Grinding to complete 360° contours

Punches and inserts of guide plate and cutting plate, with respective clamps—ground on a Studer.

ADDITIONAL SPECIFICATIONS

	PSM 250	PSM 130
Maximum template length	24"	16"
Profile length in one setting	16"	6"
Diameter of crushers or rolls	10"	4"





Profile grinding of a flat form tool.

A Studer set up for cylindrical grinding. Workpiece held between centers.

Write For More Information

COSA

Importers of Leading Precision Machine Tools
Nationwide Sales and Service
COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.

IN CANADA contact COSA CORPORATION OF CANADA, LTD., 1160 Lakeshore Rd., Long Branch, Toronto 14, Ont.

GEARS

Designed and
Manufactured to meet

YOUR

Production Requirements

Custom Gears Exclusively

DIEFENDORF

GEAR CORPORATION SYRACUSE 1, N. Y.

For more data circle item 275A on Card

SECOND EDITION

DIE-CASTING

By Charles O. Herb

DIE-CASTING, by Charles O. Herb, Editor of MACHIN-ERY, covers die-casting from its earliest phases up to today's advanced practices. It is a valuable reference work for everyone engaged in the design, production or use of die-castings.

die-castings. The latest models of automatic and manually operated diecasting machines are illustrated and described, including fully hydraulic machines of the vertical and horizontal coldchamber types, air-operated vertical machines, machines convertible from cold-chamber to gooseneck type operation, etc. Tables of die-casting alloy compositions include the latest developments, and are supplemented by text discussion of their properties and applications. 310 pages, 196 illustrations. \$5.00. Send your order to:

THE INDUSTRIAL PRESS, 93 Worth St., N. Y. 13



For more data circle item 275B on Card



IMPROVE FACING OPERATIONS

ON BORING MILLS - DRILLS - LATHES MILLERS AND RADIALS

M-D facing Head feeds automatically. Lathe tool bit travels radially from center outward or reverse. 10 sizes, 6" to 46" dia. Write for bulletin, prices.

MUMMERT-DIXON CO. 126 Philadelphia St.

For more data circle item 275C on Card

CUTTING TIME THIS FAST?

TIME FOR SOME WALLACE "CUT-MACHINING" OPERATIONS

MATERIAL
1"X1"x½" Angle Iron
1" Steel Tubing
½ SEC.
½ SEC.
½" Steel Bar
3"x 16 gauge Stainless Steel Tubing
4"x2½"x¼" I-Beam
4" Iron Pipe

TIME REQUIRED
¼ SEC.
½ SEC.
10 SEC.

28 SEC.

6"x6"x1" Angle Iron



DOES A WALLACE "CUT-MACHINING" UNIT BELONG IN YOUR PLANT?

If You Prefer

Write for 12 Page Catalog containing complete specifications and examples of fast Wallace "Cut-Machining" units.



If your cutting time is more than the examples shown, it will pay you to investigate Wallace. If it is important that the cut ends be so smooth, that secondary operations are unnecessary, then that is another reason why "Cut-Machining" will lower your costs.

Investigate this industry proven machine. Without obligation, our engineers will analyze your work; will make recommendations for your jobs.

Call Factory BUckingham 1-7000
CHICAGO

and Reverse Charges PLEASE

WALLACE SUPPLIES MFG. CO.

10 W. Diversey Parkway ● Chicago 14, Illinoi For more data circle item 275D on Card need. It tells the story of three major machine tool firms, all of Springfield, Vt. It interweaves their individual histories with the history of their town and, to the greatest extent practical, of their industry. Through the corporate lives of these three companies are seen the critical issues faced in the past by this small but crucial industry. . . the deep cyclical swings characteristic of the industry, the machine tool build-ups of each of the several wars it supplied, the desperate needs for innovation in the face of widely fluctuating profits.

SOLDERING MANUAL. Prepared by AWS Committee on Brazing and Soldering. 170 pages; 6 by 9 inches; illustrated. Published by American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, \$5.

This, the first manual on soldering ever published, contains twenty-one chapters dealing with the following subjects: principles of soldering; solders; fluxes; joint design; precleaning and surface preparation; equipment, processes, and procedures; flux residue treatment; inspection and testing; copper and copper

alloys; steel; . . . stainless steels; nickel and high-nickel alloys; lead and lead alloys; aluminum and aluminum alloys; magnesium and magnesium alloys; tin; cast irons; precious-metal coatings; printed circuits; and safety. The manual is equally useful to the amateur and the professional.

Angular Tables. 511 pages; 8 1/2 by 11 inches. Published by Pratt & Whitney Co., Inc., West Hartford 1, Conn. Price, \$11.

The name of the author (the electronic brain) of this 4 1/2-lb. volume is the Bendix General Purpose Digital Computer, which logged 112 hours in accomplishing the task. It is estimated by Pratt & Whitney that two superlative mathematicians would have needed a year or two at least, working eight hours a day, to perform the same feat.

What the book provides is precise tabulations for dividing a circle into any number of equal divisions from 2 to 210, inclusive. For each of these divisions, the decimal value, the degrees, minutes and seconds, and the sine and cosine are given. The user of these tables no longer has to plough through the trigonometric equations, functions, mathematics, and heavy mental labor that were necessary before the arrival of this new electronic author.

The book was published for a reading public primarily limited to engineers, designers, draftsmen, and operators of such machines as jig borers, hole grinders, rotary tables, and measuring equipment.

AMERICAN STANDARD—HIGH-SPEED STEEL AND CAST NONFERROUS SINGLE POINT TOOLS AND TOOL-HOLDERS. ASA B5.29-1959, 7 pages; 8 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y. Price, \$1.

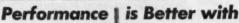
This new standard presents sizes and tolerances for the two types of tool bits, which are in common use for general-purpose machining. Excluded are specialized tool bits for such applications as screw machining, boring, etc. Nominal shank sizes of single point tool-bit holders are also included.

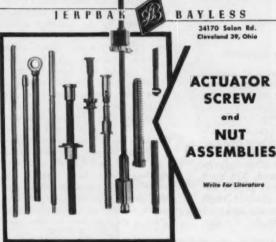
AMERICAN STANDARD — GRAPHIC SYMBOIS FOR WELDING, ASA Y32.3-1959. 87 pages; 8 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, \$3.

(Continued on page 278)









For more data circle item 277A on Card



Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at beach; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company lefterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

END NIGHT CLEANUP & MORNING REBLUING
DYKEM HI-SPOT BLUE No. 187 is used to locate high spots
when scraping bearing surfaces. As it does not dry,
it remains in condition on work indefinitely, saving
scraper's time. Intensely blue, smooth paste
spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible
tubes of three sizes. Order from your supplier.
Write for free sample tube on company letterhead.
E DYKEM CO., 2300R NORTH 11TH 51., 51. LOUIS 6, MO.
For more data circle item 2778 on Card

ALL MAKES . . . RECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO. 1470 Chestnut Ave. Hillside, N. J.

For more data circle item 277C on Card



For more data circle item 277D on Card

POWER FOR INDUSTRY

Engineering-Design office offers a completely developed air-cooled, four-cylinder (V-form), two-stroke Diesel engine.

> Power capacity 59 HP Revolutions 1800/min. Fuel consumption 2.4 gals./hr.

Approved-prototype, working drawings and parts list available. Those seriously interested are requested to write for further particulars to

WERBE-AGENTUR DR. MÜGGENBURG

Essen-Bredeney, Alfredstr. 393

West Germany
For more data circle item 277E on Card



For more data circle item 277F on Card

Developed by the American Welding Society, the symbols in this pamphlet were submitted to and approved by ASA Sectional Committee on Graphical Symbols and Designations, Y32, a committee sponsored jointly by ASME and the American Institute of Electrical Engineers. Approval by ASA represents recognition as the national standard in this field.

AMERICAN STANDARD—DRILL DRIVERS; SPLIT-SLEEVE, COLLET TYPE. ASA B5.27-1959. 9 pages; 8 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price \$1.

This 1959 standard was revised by a subcommittee of the technical committee on twist drills of the ASA sectional committee on standardization of small tools and machine tool elements. This over-all project is sponsored by the American Society of Tool Engineers, the Metal Cutting Tool Institute, the National Machine Tool Builders' Association, the Society of Automotive Engineers, and ASME.

Obituary

ALBERT E. FORBERG, a sales engineer for National Broach & Machine Co., Detroit, Mich., and a pioneer designer and engineering specialist in the broaching tool field, died in March at the age of seventy-three. He had been associated with the company since 1936. He was a member of the American Society of Tool Engineers, the Society of Automotive Engineers, and the Ford Old Timers Club.

Machinability Seminar

A machinability seminar emphasizing the new difficult-to-machine materials will be held on the campus of the Pennsylvania State University from June 6-10, 1960.

The seminar will present knowledge of fundamentals, new developments, methods and techniques, and practical applications of the results of metal cutting research. The seminar will be of value to project engineers, design and product engineers, as well as planning and tool engineers. It will, also, be of value

to plant managers, production supervision, and others who are interested in keeping abreast of the latest developments in this important field. For additional information write to: Machinability Seminar, Conference Center, the Pennsylvania State University, University Park, Pa.

International Machine Tool Standards

A number of international standards for machine tools are being considered by the member nations of the International Organization for Standardization (ISO). Two of these standards have been submitted to the ISO Council for acceptance. The two cover lathe toolposts and speeds and feeds for machine tools. Four more proposals being circulated for approval deal with a 5 per cent taper for tool shanks (Morse, metric, and Brown & Sharpe tapers); lathe centers; 7/24 tapers; and symbols appearing on the controls of machines. The last subject is aimed at substituting word descriptions with symbols that can be understood in any country in which a machine may be used.



PERFORMANCE ASSURED!

Clay-extrusion machinery will operate more efficiently thanks to these precision-built steel spur gears. Stahl met the specifications EXACTLY—38" O.D., 9" F., 24" Bore, 36 T., 1 D.P.—14" O.D., 9" F., 6" Bore, 12 T., 1 D.P. Teeth flame-hardened for long life. YOUR specifications will be equally meticulously met. Stahl's estimate will be convincing. Send for it today.



COMPANY

3901 HAMILTON AVENUE CLEVELAND 14, OHIO

For more data circle Item 279A on Card



SILENT GEARS HEAT TREATED, CASE OR FLAME HARDENED GEARS— OF CARBON OR ALLOY STEEL

> Gage Block Precision means GRADE "A" ACCURACY*

with ULTRA-CHEX GAGE BLOCKS 82 PIECE SET ... NOW ONLY \$249 50

Grade "A" Accuracy: -.000002" and +.000006"

For Complete Information request our 96 Page Catalog — Contact any of our 4 "Coast to Coast" Locations or you recreat Local Distributor.

WARHOUSE STOCK, SHOWROOMS & SALES OFFICES AT NEW YORK: 200 Larleyshire Street, New York 12, N. Y. ST. JAMES 15, Januare, Minessaying 8th of, 100 Ampeleo 19, Col. CHICAGO: 1008 W. Herricon, Chicago 44, Ili. When serking to any of the above locations, refer to DEPT B-5

For more data circle Item 279B on Card

AND FIXTURE DESIGN

A practical book with 382 pages of information on the design and construction of Jigs and fixtures for drilling, boring, planing and milling. \$5 per copy. Sent on approval.

MACHINERY, 93 Worth St., New York 13, N. Y.

DO YOU BEND?

"A MANUAL OF PROCESS for THE COLD BENDING OF METALS" and ABRASIVE CUT-MACHINING OF METALS" gives practical advice on all phases of cold bending and abrasive cutting. Simply written by shop men for shop men. Wallace Supplies Mfg. Co. Chicago 14, Illinois

1310 West Diversey Parkway

For more data circle Item 279C on Card

WICKESmanship

the "GOOD TURN" that increases crankshaft production

WICKESMANSHIP is the "TURNING POINT" that shows the way to profitmaking production. Here's engineering competence and versatility with lower initial and unit costs . . . that has produced the world's only complete line of crankshaft lathes. WICKESmanship is

the kind of technical superiority and unsurpassed quality that you demand in modern crankshaft production -it's your assurance of precision excellence-a prime factor in our 105 years of continued customer satisfaction.



CKES MACHINE TOOL

RANKSHAFT LATHES . SMALLEY GENERAL THREAD MILLERS . ENGINE LATHES ENTER DRIVE LATHES AND BORING MACHINES . SPECIAL MACHINES

For more data circle Item 279D on Card

Efficient, High-Strength Bolt Has Short Thread, Larger Head

Savings up to 40 per cent in bearing type connections over present high-strength bolts are available in applications of a new high-strength bolt with a novel head and thread design. The design has been approved after extensive testing sponsored by the Research Council of Riveted and Bolted Structural Joints and by the American Institute of Steel Construction. Source of the new bolts is Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y.

The larger bearing area under the head permits use of only one washer per bolt. This washer can be used under either the bolt head or the nut, whichever is rotated in tightening. Shorter thread length prevents the shear plane of the connection from passing through the threaded portion of the shank. Increasing the shear area of the bolt increases the allowable working shear stresses so that one-third fewer bolts are needed in the bearing type connections that form the majority of structural joints. The large-head bolt has the same

across-flats dimensions as the presently used, heavy-nut design, eliminating the requirement for the two different wrench openings presently needed.

Tightening is possible from either the nut or from the bolt head, an advantage in tight spots where clearance is a problem. The hardened washer is used under the rotated member, Exact alignment of holes in structural members is not necessary. Misalignment of as much as 1/16 inch will still permit easy hand insertion of the bolt. A recent, comprehensive analysis of fabricating assembly techniques shows that high-tensile bolting in the shop results in 66 per cent more tonnage per man-hour without an increase in shop size, handling facilities, or work force. In addition, an additional saving of 9.5 per cent results from eliminating one washer. This does not take into account a reduction in the number of fasteners per connection now possible.

The increased bearing area permits development of the full clamping

force of the bolt without using a washer under the head and without Brinelling of the work. The tensile stress that can be put into the present high-strength bolt without using a washer is 65,000 psi. The new bolt can be stressed to 85,000 psi or more without a washer.

Pretreatment Makes Welding Galvanized Parts Easy

Difficulty in welding a galvanized surface can be avoided by masking the weld areas with a solution of potassium dichromate and hot water prior to galvanizing. The solution is being used by the Westinghouse Electric Corporation's lighting division in Cleveland, Ohio, to leave a clean surface for welding on the bottom of transformer tanks. After welding, the ungalvanized surface is shotblasted and zinc-sprayed.

The masking solution consists of 32 ounces of potassium dichromate and 1 gallon of water. It is applied at a temperature from 120 to 140 degrees F. and is allowed to remain in contact with the metal for two minutes. The surface is then dried before galvanizing.

COLUMBIA

ATMODIE SMOOTHCUT (D2S) free machining high chrome air hardening die steel gives a real "run for the money."

Product of Skilled American Workmen



CLASSIFIED ADVERTISING



Classified and Resale Section

CLASSIFIED ADVERTISING RATES: \$12 per single column inch

at its Best



Miles ra-building often adds features not present in the original manhime. Here Miles mechanics are pra-paring the bad of a 60 inch x 3-4 ft. Miles lathe to receive hardened steel wearing plates. The result is greater accuracy over a longer period of time.

BORER, No. 47A Heald Borematic, spl. end precision,

43
BROACH, 10 ton 66" st. Bligear vert. byd. dbi slide
DRILL, HORIZ., Medel 420 W.F. & John Barnes
deep hole, late
DRILL, N. Dy., 20" No. 217 Baker hy. dy.
DRILL, Davis & Thompson Reformatic, Medel SLV,
20 WP

20 MF GRINDER, GVL., 22"x72" Landis byd. GRINDER, DISC, 22" Nodel 221 Hansbett opposed wases, 10 MF GRINDER, SURFACE, 20" No. 25A Heald byd.

GRINDER, SUNFACE, 20" No. 23A Heald hyd.
GRINDER, T. & C. Cincinnati Monoset
GRINDER, T. & C. Model HRS Berber-Colman
GRINDER, T. & C. Model HRS Berber-Colman
GRINDER, T. & C. Model LRS
GRINDER, T. & C. Model
ATHE. AUTOMAYIC, Model 10-34" Sundstrand,
new 49
LATHE. RUTOMAYIC, Model 10-34" Sundstrand,
new 49
LATHE. ENGINE, 16" x 58" cc American Pacemaker,
Timben boaring
HILL, 5748 Cincinnati Hotomatic, duplex
MILL, Mo. 2 Cincinnati Hec. 0.a., PRT 19, heriz.
MILL, MREAD, Mo. 4 Lees Bradner Univ.
MILLS, PLANER, 42" x 42" x 18" Ingered Univ.
MILLS, PLANER, 42" x 42" x 18" Ingered Univ.
MILLS, PLANER, 42" x 42" x 18" Ingered Univ.
MILLS, PLANER, 42" x 42" x 18" Ingered Univ.
MILLS, PLANER, 36" x 10" Liberty box table
PRESS, 10" to 56" x 10" Liberty box table
PRESS, 10" to 56" x 10" Liberty box table
PRESS, 18 12 Ston Model F1125-30-125 Clearing,
RRLLS, M. 18 Kane & Roach transpittering
CUT-0FF MACHINE, 3" No. 3 Modern
SMAPER, 22" Reckford "My-Draulie" univ.
LSTTER, 28" Rockford "My-Draulie" univ.
TESTER, 200.000 inch-pound Timiss Gisen No. 2,
torsion
UPSETTER 2" National, air clutch

torsion
UPSETTER 2" National, air clatch
UPSETTER 2" National, air clatch
EENDER, Cyril J. Bath dbl. wing by. dy. tangent
DUPLICATOR No. BL2416 3 Sgdl. PAW Keller
WIRE MACHINERY, No. 35 MS Matti-slide 4 slide,
new 5G
GRINDER, INTERNAL 16-38 Bryant hole, late

OVER 1,000 NEW AND USED MACHINE TOOLS IN STOCK

MILES MACHINERY COMPANY

WRITE FOR LATEST STOCK LIST

2045 EAST GENESEE . SAGINAW, MICH. PL. 7-3105

Excellent Opportunity For Successful (only!) MACHINE TOOL SALESMEN

Further expansion of S & S Machinery Co. provides top opportunity for first rate sales engineers.

S & S MACHINERY COMPANY 140 53rd Street-Brooklyn 32, N. Y.

new 4th printi MACHINE TOOL RECONDITIONING

& the Art of Hand Scraping Send for free folder describing illus, book. MACHINE TOOL PUBLICATIONS
215 Commerce Bidg., South Wabash St.
St. Paul 1, Minn.

astern Rebuilt Machine Tools THE SIGN OF QUALITY -

THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—The LEADER IN THE FIELD OF RESULTIN MACHINE TOOLS.

dodel ESM-59 Hardinge Precision Ram Type, m.d.

10. 1 LeBlond Automatic Turbine Wheel, Hydra-Trace
Attachment, m.d.

27 Schastian "Viling" med.

28 Schastian "Viling" med.

28 Schastian "Viling" med.

29 Schastian "Viling" med.

29 Schastian "Viling" med.

29 Schastian "Viling" med.

20 Schastian "Viling" med.

20 Schastian "Viling" med.

20 Schastian "Viling" med.

20 Schastian "Viling" med.

21 Schastian "Viling" med.

22 Schastian "Viling" med.

23 Schastian "Viling" med.

24 Schastian "Viling" med.

25 Schastian "Viling" med.

26 Schastian "Viling" med.

26 Schastian "Viling" med.

27 Schastian "Viling" med.

27 Schastian "Viling" med.

28 Schastian "Viling" med.

28 Schastian "Viling" med.

29 Schastian "Viling" med.

20 Schastian "Viling" med Model ESM-59 Hardinge Precision Ram Type, m.d. No. 1 LeBlond Automatic Turbine Wheel, Hydra-Trace

m.d. 10x54 centers IeBlond H.D., m.d. 18x48 centers Lodge & Shipley G.H., m.d. 22" Model M—actual swing 27 ½"x336" Monarch, m.d.

MANUFACTURING LAYNES

4860" LoSwing, m.d.

10x20" centers Hi-Turn, new

11x18" LeBlond Rapid Production, m.d.

12x18" Reid Small Piece Production, Model 6WSL, m.d.

12x18" Reid Small Piece Production, Model 6WSL, m.d.

14x21' centers Model LS Semi-Automatic LoSwing, m.d.

17x755%" LeBlond, m.d.

No. 24 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

No. 34 Lodge & Shipley Duomatic, m.d., late type

4 R. R. LeBiond Boring Lattie, 37 Ded, 4 d., latest 9, 12 LeBiond Multi-Cut, m.d. 10 Sundstrand Automatic Production, m.d. 12 Sundstrand Automatic Production, m.d. 12 Gisholt Auto. Production, m.d. 16 LeBiond Automatic, m.d. Semi-Automatic Carbo Lathe, m.d.

Colburn Mfg. Bench Type Speed Lathe, m.d. Model NA2B Schauer Speed Lathe No. 9WSL Beid Production, m.d. 12"x12" centers Model 5T Monarch, m.d.

MANUFACTURING TYPE MILLING MACHINES

MANUFACTURING TYPE MILLING MACHINES
No. 000 Brown & Sharpe Plain Predaction, m.d.
No. 000 Brown & Sharpe Plain Predaction, m.d.
No. 300 Taylor & Fenn Duplex, soline, m.d.
No. 331 Sundstrand Triplex Eigidmill, m.d.
No. 334 Sundstrand Triplex Eigidmill, m.d.
No. 38 Sundstrand Triplex Eigidmill, m.d.
24" Cincinnati Duplex Automatic, m.d.
Model 1404 Kearner & Trecker Simplex, m.d., production
3-24" Cincinnati Plain Hydromatic, m.d. in base
3-36" Cincinnati Duplex Hydromatic, m.d. in base
3-36" Cincinnati Plain Hydromatic, m.d. for Sharper & Type
Bigidmill, m.d.
No. 34-36 Cincinnati Semi-Special Plain Hydromatic,
tracer control
5-96 Cincinnati Plain Hydromatic, m.d. in base, 1944
36"\$120" Cincinnati Plain Hydromatic, m.d. in base, 1944
36"\$120" Cincinnati Plain Hydromatic, m.d. in base, 1944

36"x120" Cincinnati Horizontal Hydrotei Mille new, late M54 Taylor & Fenn Soline Miller, belt drive No. 11-18 Cincinnati Plain Automatic, m.d.

HAND MILLERS

Van Norman, m.d., 1947

PLAIN MILLING MACHINES

PLAIN MILLING MACHINES

No. 3 Cincinnati Plain H.P., m.d.
No. 3 Cincinnati Plain H.S. Dual Type, m.d.
No. 1B Milwaukee, m.d., in rear
No. 2 Cincinnati H.P., m.d.
No. 2Mil Cincinnati H.B., m.d.
No. 2Mil Milwaukee, m.d.
No. 3B Milwaukee, m.d.
No. 3B Milwaukee, m.d.
No. 3B Milwaukee, m.d.
No. 4B Kearner & Trecker, m.d.
No. 4H Kearner & Trecker, m.d.
No. 5 Cincinnati H.P., m.d.
No. 5 Cincinnati H.P., m.d.
No. 2 M. Norman, m.d.
No. 36 Wan Norman Basa Type, m.d.
No. 2 M. L. Cincinnati, m.d.

THREAD MILLING MACHINES

10x48" Hansen & Whitney Universal Semi-Automatic, 10xee* namen a wintery universal Semi-Automatic, m.d.
2x56" Lecs-Bradner Universal Type, m.d.
12x16" Lecs-Bradner Universal Type, m.d.
12x102" Lecs-Bradner Universal Type, m.d.
12x102" Lecs-Bradner Universal Type, m.d.
12x102" Lecs-Bradner Universal Type, m.d.
No. 40 Lecs-Bradner Automatic Universal m.d., late
Model HT—12x102" Lecs-Bradner Universal Type, m.d.

The above is only a partial listing WRITE FOR COMPLETE STOCK LISTING

THE EASTERN MACHINERY. COMPANY

1006 Tennessee Avenue, Cincinnati 29, Ohio . MElrose 1-,1241 . Cable Address EMCO

BOOKS... give you the answers to your design and production problems. And it's easy to get them by mail. Just read the descriptions on the insert opposite the back cover, and use the prepaid order card to get the ones you want.

Diffusion-Welding Improvement Reduces Heat and Deformation

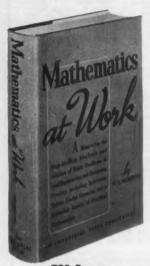
Advances in diffusion-welding methods now obtain excellent bonds at temperatures as low as 650 degrees F. The new method, developed at Battelle Memorial Institute, Columbus, Ohio, involves the use in the joint of one or more intermediate metals, usually applied by plating.

Intermediate metals permit joining at temperatures far below those required if two pieces of metal are pressure-bonded directly. In some cases, the reduced temperature may also drastically reduce or even eliminate deformation during bonding.

One successful application was a Monel metal and beryllium-copper throat block for an unusually high-speed wind tunnel. The block itself was made of Monel metal with cooling grooves cut in its surface. A sheet of beryllium copper had to be welded to this surface to cover the cooling grooves.

While the beryllium-copper sheet could have been attached by brazing, problems were encountered in trying to heat-treat the sheet to the strength level required. Diffusion welding solved the problems. Using copper and silver as intermediate materials in the joint, excellent bonds were obtained between the beryllium-copper sheet and the throat block at 650 degrees F., the age-hardening temperature for the beryllium copper. Thus, required strength was obtained in the cover sheet at the same time as it was bonded to the block. Moreover, bonding at this temperature avoided the distortion encountered when brazing was attempted. The joints obtained in this application have unusually high strength. Applied to certain other applications, diffusionbonded parts have been used successfully at temperatures well above the bonding temperature.

Improve Your Ability To Use Shop Mathematics



728 Pages
196 Illustrations

\$7.50

MATHEMATICS AT WORK is a convenient, comprehensive problem-solving guide that is applicable to a wide range of mechanical problems. It is written expressly to show you how arithmetic, algebra, geometry, trigonometry, and logarithms are applied to problems taken from the metalworking field. It shows you how to use approximate formulas and trial-and-error methods; explains the reason for and the application of empirical working formulas; gives salient facts about allowable errors and how to handle them; includes a comprehensive "refresher" review.

Actually three books in one, MATHEMAT-ICS AT WORK contains 100 pages of fundamentals which are needed whenever mathematics is put to work; 482 pages of illustrated mechanical problems with step-by-step solutions; and 146 pages of standard mathematical tables applicable to all types of practical problems.

Order your copy of this valuable reference book today! To receive this practical manual and strengthen your foundation of mathematical knowledge, mail the convenient order form below.

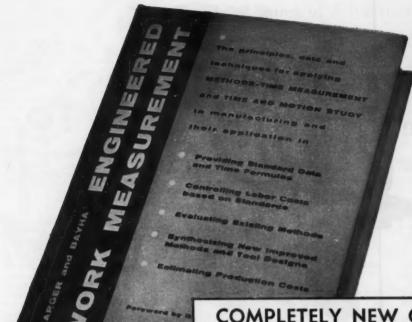
Rail Welding Film

A new railroad motion picture, "Clear Board For Ribbonrail," has just been released by the Oxweld Railroad Department of Linde Company, division of Union Carbide Corporation. Photographed entirely on location at railroad sites, the film tells the complete story of Linde's "Ribbonrail" Service to railroads during the installation of continuous-welded rail. It shows the step-by-step process of welding, transporting, and laying this rail. A highlight of the film is a section showing the welding and installing of a high-speed welded rocket-test track at Edwards Air Force Base, Calif. These scenes show the rail being welded, installed on a reinforced concrete roadbed, and aligned to the extremely critical tolerance of plus-or-minus 0.036 inch. To borrow a free copy of this twentyfour minute, 16-millimeter, colorsound film, write to W. J. Corriveau, Oxweld Railroad Department, Linde Company, 230 N. Michigan Ave., Chicago 1, Ill.

A long-term lease plan for its complete line of standard and custom steel presses and press brakes has been announced by Verson Allsteel Press Co., Chicago, Ill. This lease plan features terms starting at three years. It will enable concerns to install modern equipment immediately without reducing their working capital resources. The Nationwide Leasing Co., also of Chicago, will underwrite the program.

_MAIL THIS ORDER FORM TODAY_____

THE INDUSTRIA	L PRESS, 93 Worth Street, New York 13, N. Y.
	opy of Mathematics At Work or money order in full payment. Send book postpaid. Bill Company.
	gn countries-except Canada—must be accompanied by paying 50¢ postage and handling charges.)
Name	Position
Firm	
Firm Address	
City	Zone State



COMPLETELY NEW COVERAGE OF METHODS—TIME MEASUREMENT and TIME AND MOTION STUDY

ENGINEERED WORK MEASUREMENT is a comprehensive, up-todate treatise for solving problems of Methods-Time Measurement (MTM) and Time and Motion Study. It will help you analyze and eliminate wasteful and inefficient procedures and set up sound money-saving methods for all types of work operations. History, fundamentals, mathematics, applications and standards of MTM are covered. Complete tables and an official MTM working data card are also included for direct applications to specific work measurement problems.

It also presents a thorough survey of Time and Motion Study covering background and uses, and describing the latest and best in techniques and equipment. For the first time MTM and Time and Motion Study are presented as complementary rather than opposing systems, for a more efficient approach to and better solution of every type of work measurement problem.

ENGINEERED WORK MEASUREMENT will provide industrial engineers and managers, methods engineers, process engineers, MTM practitioners, time and motion study men, students and foremen with a thorough working knowledge of the principles, techniques and data of work measurement.

Design engineers, tool engineers and foremen will find the chapter on Simplified MTM especially suitable in helping to determine which of several work methods is the most efficient for performing a given operation.

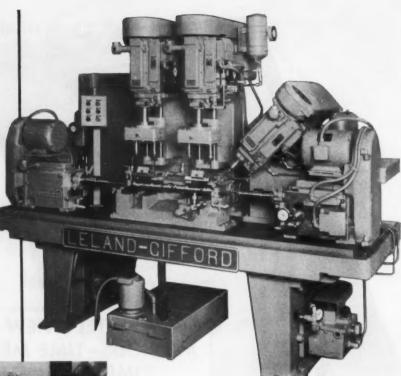
Send for your copy today!

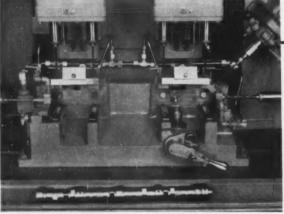
	630 Pages	
	120 Illustrations	
Official	MTM Data Card Insert	ł
	\$12.00	

The Industrial Press, 93 Worth Street, New York 13, N. Y.
Please send me a copy of ENGINEERED WORK MEASUREMENT
I enclose check or money order for \$12.00
Send book under Five-Day Free Inspection Plan. If I decide to keep book I will send payment, plus postage charges within five days.
☐ Bill me ☐ Bill Company
Name
Company
Company Address

M/5/60

Here's an idea you can use to cut precision drilling costs....





One machine, one handling, one quick, simple operation does all the precision drilling on this camshaft. Note that this is not ordinary gang drilling - the job involves axial, angular and cross holes as well as reaming.

Leland-Gifford has time-saving, cost-cutting ideas for you, too - ways you can combine multiple operations into a simple, efficient unit operation.

THE JOB: Drill one end of camshaft and ream the other while drilling four cross holes and one angular oil hole.

THE MACHINE: A Leland-Gifford special with five No. 2 self-contained units and standard hydraulically clamped fixture interlocked with drilling units to start feed after clamping and to unclamp when operation is finished. SC units are interlocked to prevent interference between cross and axial drills. One operator completes 60 camshafts per hour at 100% efficiency.

For Automatic Drilling at its best be sure to see Leland-Gifford

CALL THE OFFICE NEAR YOU

LELAND-GIFFORD SPECIAL DRILLING MACHINES

WORCESTER 1, MASSACHUSETTS

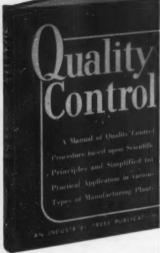
Detroit 10429 W. McNichols Rd. Cleveland 22 P. O. Box 853

Indianapolis 6, P. O. Box 1051 Rochester 12, P. O. Box 24, Charlotte Station

Alphabetical Index of Advertisers

Alph	abetical index of Advert	isers
Ace Drill Corp. 288 Airborne Instruments Laboratory 289 Allegheny Ludlum Steel Corp. 265 Allen, Alva, Industries 277 Allen-Bradley Co. Insert 73-74 Allen Manufacturing Co. 232 American Brass Co. 215 American Schiess Corp. 92 American Sip Corp. 96 American Steel Foundries 170-171 American Tool Works Co. 191 American Waldrich Mfg. Corp. 93 Armstrong-Blum Mfg. Co. 253 Armstrong Bros. Tool Co. 247 Aro Equipment Corp. 33 Atlas Press Co., Clausing Div. 90 Austin Industrial Corp. 270	Fairbanks, Morse & Co. 176 Farval Div., Eaton Mfg. Co. 85 Federal Bearings Co., Inc. 221 Fellows Gear Shaper Co. 4-5 Fiske Bros. Refining Co., 220 Lubriplate Div. 220 Fosdick Machine Tool Co. 38 Gardner Machine Co. 21, 43 Giddings & Lewis Machine Tool Co. Co. 88-89 Gisholt Machine Co. 36 Gleason Works 37 Goss & DeLeeuw Mch. Co. 242 Gray, G. A. Co. 22-23 Great Lakes Steel Corp., Div.	National Machine Tool Builders 200 National Tube Div., United States 255 Steel Corp. 255 National Twist Drill & Tool Co. 27 New Britain Machine Co., The New Britain-Gridley Machine Div. Insert 45-46 New Jersey Gear & Mfg. Co. 277 New Jersey Zinc Co. 195 Norton Company 14-15, 50-51 Oakite Products, Inc. 54 Orban Kurt, Co., Inc. 181 Osborn Manufacturing Co. 206
B&T Machinery Co Insert 78 Babcock & Wilcox Co., Tubular Products Div 271 Ball & Roller Bearing Co 277 Barber-Colman Co Insert 82-83	National Steel Corp. 94-95 Greenfield Tap & Die Div. United Greenfield Corp. 193 Greaves Machine Tool Co. 246 Grieder Industries, Inc. 266	Pangborn Corp. 290 Pope Machinery Corp. 254 Pratt & Whitney Co., Inc. 58-59 Producto Machine Co. 65
Bardons & Oliver, Inc. 87 Barnes Drill Co. 189 Baush Machine Tool Co. 219 Beatty Machine & Mfg. Co. 222 Bethlehem Steel Co. 209, 243 Birdsboro Corp. 269 Blanchard Machine Co. 223 Brown & Sharpe Mfg. Co. 200	Hamilton Tool Co. 264 Hardinge Brothers, Inc. 60, 98 Heald Machine Co. The Inside Front Cover 273 Hoover Ball & Bearing Co. 229 Hydraulic Press Mfg. Co. 29 Hydromation Filter Co. 216	Reed Rolled Thread Die Co. 236 Reliance Electric & Engineering 20 Co. 32 Rivett Lathe & Grinder, Inc. 66-67 Rockford Machine Tool Co. Insert 80-81 Ross Operating Valve Co. 173 Rowbottom Machine Co. 42
### Front Cover, 16-20 Buckeye Tools Corp	Illinois Gear & Machine Co 199 Industrial Press 283, 286	Ruthman Machinery Co 238 Ryerson, Joseph T. & Son, Inc 100 SKF Industries, Inc 211
Capewell Mfg. Co	Jacobs Mfg. Co. 30-31 Jerpbak-Bayless 277 Jones & Lamson Machine Co. 267 Kearney & Trecker Corp. 233 Kennametal, Inc. 207 Kirk & Blum 226	Scherr Tumico 279 Schrader's A., Son Div., Scovill Mfg. Co. Inc. 239 Seneca Falls Machine Co. 256 Sheffield Corp. 251 Sheldon Machine Co., Inc. 268 Shore Instrument & Mfg. Co., Inc. 248 Skinner Electric Valve Div., Skinner Chuck Co. Insert 55-56 Snyder Corp. 179 Stahl Gear & Machine Co. 279
Co	L & J Press Corp. 260 Landis Machine Co. 2-3 Landis Tool Co. 8-9 Lapointe Machine Company 183 Leland-Gifford Co. 284 Lempco Industrial, Inc. 276	Standard Oil Co. (Indiana) 62-63 Sterling Grinding Wheel Co 69 Sundstrand Machine Tool Div., Sundstrand Corp Insert 76-77 Thompson Grinder Co 231
Inc. Back Cover Cleveland Crane & Engrg. Co. 64 Columbia Tool Steel Co. 280 Columbus Die-Tool & Mch. Co. 230 Continental Div., Ex-Cell-O Corp 235 Cosa Corp. 274 Cross Company 24-25	Lepel High Frenquency	Thomson Industries, Inc 167 Threadwell Tap & Die Co. Inside Back Cover Timken Roller Bearing Co. Steel & Tube Div 249
Crucible Steel Co. of America 70-71		U.S. Industries, Inc.,
Danly Machine Specialties, Inc 241 Davis & Thompson Co 272 Detroit Power Screwdriver Co 240 Diefendorf Gear Corp 275	Machine Tool Exposition 200 Marac Machinery Co. 28 Marlin-Rockwell Corp. 263 Marvel Engineering Co. 208 Mattison Machine Works Insert 79	Clearing Div. Back Cover U.S. Tool Company, Inc. 10-11 United States Steel Corp. 255 Universal Engineering Co. 86
DoAll Co. 217 Dykem Co. 277	Meehanite Metal Corp	Verson Allsteel Press Co 257 Wallace Supplies Mfg. Co 275, 279
Eaton Mfg. Co., Farval Div. 85 Edlund Machinery Co. 187 Eisler Engineering Co. 275 Eldorado Tool Mfg. Corp. 218 Elmes-King Div., American Steel 170-171 Engis Equipment Co. 210	Minster Machine Co. 197 Moline Tool Co. 262 Monarch Machine Tool Co. 61 Muggenberg, Dr. 277 Mummert-Dixon Co. 275	Warner & Swasey Co. 12-13 Wheelock, Lovejoy & Co., Inc. 204 Wickes Machine Tool Div., 279 Wickes Corp. 279 Wilson, K. R. 225 Winter Bros. Co. 26
Englehard Hanovia, Inc.,	National Automatic Tool Co., Inc.	Yoder Co
Industrial Diamond Div 201- 203 Erie Foundry Co	Insert 34-35 National Broach & Machine Co. 237	
Ex-Cell-O Corp 91, 235	National Machinery Co 68	Zagar, Inc 213

IMPROVE YOUR PRODUCT ■ REDUCE COSTS TOO!



New fourth edition—simplified for practical application—presents the latest and best techniques of statistical quality control:

- Statistical evaluation of tolerances
- Process investigation (evolutionary operation to achieve optimum quality and production)
- · Ready-made sampling plans
- · Control charts
- Illustrations and step-by-step examples
- Tabulated data

Quality Control is an up-to-date manual that is simpler yet more complete than any other text on this subject. It is, first and foremost, a practical working tool that contains easy-to-read data, ready to be applied in every kind of manufacturing plant. Emphasis is on clarity. Modern methods of statistical quality control are explained in simple terms and step-by-step examples. Wherever possible, computations have been replaced with ready-made tabular data. The new fourth edition explains the use of statistical evaluation of tolerances as an aid in establishing and maintaining realistic tolerance specifications. It also describes a new technique on process investigation and evaluation that will help you find the process settings that will yield optimum quality and productivity. The author, Norbert L. Enrick, is well known as a consultant for over a hundred industrial plants, and as a teacher of quality control. He has carefully selected illustrations from his work in the metalworking, electronic, chemical, food and textile industries as examples of the scientific principles and methods he sets forth.

MATERIAL COVERED IN TWENTY-ONE CHAPTERS

CONTROL CHARTS

Charts based on maximum and minimum specifications.
Charts based on average specifications.
Special charts for old and worn equipment.
Charts for defects control.
Charts for control of machine efficiency and productivity.

SAMPLING PLANS

Ready-made sampling tables, with plans ranging from 0.25 to 12 Per Cent Defectives and Lot Sizes up to 100,000.
 Separate tables for piece parts and continuous product.
 Regular and sequential procedures.

TOLERANCING

Basic tolerance systems.
 Evaluation of product tolerance against frequency patterns.
 Evaluation of tolerance combinations.
 Statistical tolerancing to achieve realistic specifications.

EXPERIMENTING IN THE PLANT

Simplified uses of analysis of variance in quality investigations.
 Determination of optimum processing settings through "evolutionary operation."

MANAGEMENT ASPECTS

Principles.
 Organization.
 Installation.
 Reports.
 Case Histories.

BACKGROUND MATERIAL

Fundamentals of inspection, gaging and testing in modern mass production.
 Statistical Basis of modern quality control.
 Common interchangeable terms.

INCLUDED ARE

Over 50 illustrative examples from all types of applications.
 Convenient reference tables and charts.
 Many diagrams and charts.

ORDER YOUR COPIES TODAY!

216 pages, 43 illustrations. \$5.50

Mail to: THE INDUSTRIAL PRESS, 93	Worth St., New York 13, New York
Please send me copies of Quality Control @ \$5.50.	Name
_ bill me _ bill company	Company
	Company Address
Orders from foreign countries—except Canada—must send payment In full including 50¢ per book postage and handling charges.	Home Address

free literature guide

Want more information? Below are listed the products described in this issue.

Page number after company name refers to location of ad and number to be circled on cards for literature.

This guide is compiled as a convenience to our readers. Every care is taken to keep it accurate.

Machinery assumes no responsibility for errors or omissions.

Machinery assumes no responsi	
*Advertisement appeared	
AIR TOOLS, PORTABLE Aro Equipment Corp	Malleable Castings Council * Meehanite Metal Corp 175
BALANCING MACHINES Cosa Corp *	CASTINGS, NON-FERROUS Shenango Furnace Co *
BAR MACHINES, AUTOMATIC Cleveland Automatic Mch. Co. New Britain Machine Co 46	CHUCKING MACHINES, AUTOMATIC Goss & de Leeuw Machine Co 242 Hardinge Brothers, Inc *
BEARINGS Ball & Roller Bearing Co 277F Fafnir Bearing Co *	New Britain Mch. Co 45 Warner & Swasey Co 12-13 CHUCKS
Federal Bearings Co., Inc. 221 Hoover Ball & Bearing Co. 229 Marlin-Rockwell Corp. 263 Nice Ball Bearing * SKF Industries 211 Timken Roller Bearing Co. *	Buck Tool Co. * Cushman Chuck Co. * Hanchett Magna-Lock Corp. * Jacobs Mfg. Co. * Skinner Chuck Co. * Walker, O. S. Co. *
BEARINGS, BRONZE Bunting Brass & Bronze Co *	CLAMPING DEVICES & FIXTURES Armstrong Bros. Tool Co *
BENDING EQUIPMENT, PIPE & TUBE Wallace Supplies Co 275D	Universal Engrg * Vlier Engrg., Wespo div *
BORING MACHINES Ex-Cell-O Corp *	CLEANERS, METAL Oakite Products, Inc 54
Fosdick Mch. Tool Co. 38 Marac Mchry. 28 New Britain Mch. Co. *	COLD FORMING EQUIPMENT Cincinnati Milling, Metadynamics div *
BORING MILLS, HORIZONTAL Giddings & Lewis Mch. Tool Co	Dynapak * National Machinery Co. 68 Waterbury Farrel Foundry * Yoder Co. 48
BORING MILLS, VERTICAL American Schiess Corp 92-93 Elmes/King div. American Steel Foundries 170-171	COLLETS Hardinge Brothers, Inc 60 Jacobs Mfg. Co 30-31
Gray, G. A. Co * Lucas div. New Britain Mch.	COMPONENT FABRICATIONS Kirk & Blum Mfg. Co 226
Co	COOLANT UNITS Little Giant Pump Co 278
American Brass Co 215 Revere Copper & Brass, Inc *	CONTRACT WORK Textile Machine Works *
BROACHING MACHINES Sundstrand Meh. Tool Co 77	CONTROL DEVICES, ELECTRONIC Hughes Products *
BUSHES, TENSION Gillen, John C *	CONTROLS, ELECTRICAL Allen-Bradley Co *
BUSHINGS, BALL Thomson Industries, Inc 167	COPPER American Brass Co 215
Eisler Engineering Co 275B Rowbottom Mch. Co 42	Revere Copper & Brass, Inc * CUT-OFF MACHINES A word none Plans Mfg. Co *
CARBIDE TOOLS & DIES Allegheny Ludlum, Carmet * Metal Carbides Corp	Armstrong-Blum Mfg. Co * DoAll Co

STANDARD REFERENCES ON DIE DESIGN, DIEMAKING AND DIE-CASTING



DIE DESIGN AND DIEMAKING PRAC-TICE is a book by diemakers for diemakers—on design, construction and application of sheet-metalworking dies. Drawings, descriptions and data tell how to use proved methods, principles; how to avoid mistakes and delays. If you design, make or use dies for blanking, forming or drawing sheet metal parts, you should own this book. 1083 pages, 661 illus. \$10.00



DIE-CASTING is a valuable reference for everyone in the design, production or use of die-castings. Die-casting machines are illustrated and described. Tables of diecasting alloy compositions are supplemented by text on their properties and applications. 297 pages, 189 illus. \$5.00.

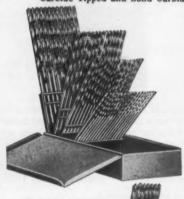
Use this order coupon!

mi					,		W			-				_	-	- 1	-			
Please	sen	d n	ne:																	
		pies actio								•	ın	d	0	lie	91	n	a	ki	in	9
	co	pies	0	f	Die	9-1	Ca	st	ir	19		6)	1	5		0	0		
☐ Pay	1	nel	054	d;	5	er	nd	1	96	si	p	al	d							
☐ Bill	m	•]	Bi	11	6	0	m	pe	ın	y							
Name																				
Compa	ny																	×		
Compo	ny	Ad	dre	185																
compe																				

Toughest, hardest, strongest ... none finer at any price:



Premium Quality High Speed Steel Carbide Tipped and Solid Carbide



DRILL SETS
Standard Fractional, Wire
and Letter series drills
conveniently packed in
folding indexed cases.

BLANK SETS

Consist of uniformly hardened high speed steel drill and reamer blanks -precision ground to new close tolerances.

Call your local distributor today—or write Ace direct for latest catalog and price information.



CUTTING & GRINDING FLUIDS
Div
Cincinnati Milling Products Div
Stuart, D. A. Oil Co. *
Texaco, Inc. *
CUTTING TOOLS
Ace Drill 288
Continental div. Ex-Cell-O 235 Eldorado Tool & Mfg. Corp 218
Mohawk Tools Inc.
Mohawk Tools, Inc * National Twist-Winter Bros. 26-27
Standard Tool Co. *
Standard Tool Co * Threadwell Tap & Die Co.
Inside Back Cover
CYLINDERS Hannifin Co. *
Hannifin Co
Schrader's A & Son *
Schrader's, A. & Son * Vickers, Inc *
DIAMONDS, INDUSTRIAL
Engelhard Hanovia div 201-203
1
B & T Mchry. Co 78
Cleco div. Reed Roller Bit *
DIE SETS
Producto Mch. Co 65
DOWEL PINS Allen Mfg. Co 232
DRILL BUSHINGS Universal Engrg. Co 86
DRILL HEADS Thriftmaster Products Co * U. S. Drill Head Co. *
U. S. Drill Head Co *
U. S. Drill Head Co
DRILL SHARPENERS
Cincinnati Lathe & Tool Co 185
DRILLING MACHINES
American Tool Works Co 191
Baker Bros. Inc.
Baush Mch. Tool Co 219 Brown & Sharpe Mfg. Co 17, 20
Buffalo Forge Co.
Burg Tool Mfg. Co 40-41
Carlton Mch. Tool 227
Delta Power Tool Div
Johansson, I. O. Co
Leland-Gifford Co 284
Moline Tool Co 262
DRIVES & DRIVE SYSTEMS
Reliance Electric & Engrg. Co.
FACING HEADS
Mummert Dixon Co 2750
FASTENERS Allen Mfg. Co
Russell Rurdsell & Word
Nut & Bolt Co
Safety Socket Screw Co
FEEDING EQUIPMENT
Detroit Power Screwdriver 24
FILTERS
Hydromation Filter Co 21
FINISHING MACHINES, METAL
Osborn Mfg. Co 20 Pangborn Corp
1 anguorn corp 29

FORGING MACHINES Ajax Mfg. Co
GAGING & MEASURING EQUIPMENT 289 Airborne Instruments 289 Ames, B. C. Co. * Brown & Sharpe Mfg. Co. 18 Engis Equipment Co. 210 Ex-Cell-O Corp. * Federal Products Corp. * Scherr Tumico 279B Sheffield Corp. * Van Keuren Co. *
GEAR CHECKING EQUIPMENT Orban, Kurt Co., Inc 181
GEAR CUTTERS Fellows Gear Shaper Co 4-5 Gleason Works 37 National Broach & Machine Co. 237
GEARS Avondale Marine Ways, Inc. * Boston Gear Works * Cincinnati Gear Co. 234 Diefendorf Gear Corp. 275A Gleason Works * Illinois Gear & Mch. Co. 199 New Jersey Gear Co. 277C Stahl Gear & Mch. Co. 279A
Blanchard Machine Co
GRINDING MACHINES, TOOL Barber-Colman Co * Oliver Instrument Co *
GRINDING WHEELS 29 Cincinnati Milling Mch. Co. 39 Macklin Co. * Norton Co. 50-51 Sterling Grinding Wheel Co. 69
HARDNESS TESTERS Clark Instrument
HONING EQUIPMENT Barnes Drill Co
HOSE & HOSE FITTINGS Parker-Hannifin *
INDUCTION HEATING EQUIPMENT Induction Heating Co * Lepel High Frequency Laboratories, Inc 214
JIG BORERS & GRINDERS Austin Industrial Corp 270

JIGS & FIXTURES	POWER UNITS. HYDRAULIC
Columbus Die-Tool & Mch. Co. 230	POWER UNITS, HYDRAULIC Ex-Cell-O Corp 91
Moore Special Tool Co., Inc *	******
Orban, Kurt Co., Inc *	PRESSES Allen, Alva 277D
***	Beatty Mch. & Mfg. Co 222
JIG MILLS	Birdsboro Corp 269
DeVlieg Mch. Co *	Bliss, E. W. Co *
KEYSEATERS	Chambersburg Engrg. Co 250
Mitts & Merrill *	Cleveland Punch & Shear *
	Danly Mch. Specialties, Inc 241
LATHES	Denison Engrg. div
American Schiess Corp 92-93	Elmes/King div. American
American Tool Works Co * Barber-Colman Co 82-83	Steel Foundries 170-171
Bardons & Oliver 87	Erie Foundry Co
Bullard Co *	Hydraulic Press Mfg. Co 29
Cincinnati Lathe & Tool Co *	L & J Press Corp 260
Clausing Div., Atlas Press Co. *	Lempco Industrial, Inc 276
Clearing div.,	Minster Machine Co 197
U. S. Industries Back Cover	Niagara Mch. & Tool Works *
Gisholt Mch. Co 36	Precision Welder & Flexopress *
Hardinge Bros 98	Steelweld div., Cleveland Crane *
Jones & Lamson Mch. Co 267 LeBlond Mch. Tool Co *	Verson Allsteel Press Co 257
Logan Engrg. Co *	Wilson, K. R 225
Monarch Mch. Tool Co 61	PRESS FEEDING EQUIPMENT
New Britain Mch. Co *	Beckett-Harcum Co *
Pratt & Whitney Co *	Littell, F. J. Mch. Co *
Rivett Lathe & Grinder 66-67	Rowe Machinery & Mfg. Co *
Seneca Falls Mch. Co 256	U. S. Tool Co., Inc 10-11
Sheldon Mch. Co., Inc 268	PUMPS
Sundstrand Mch. Tool Co 76	Brown & Sharpe Mfg. Co 19
Warner & Swasey	Fairbanks, Morse *
Wickes Mch. Tool Div 279C	Ruthman Machinery Co 238
LAYOUT FLUID	PUNCHING & NIBBLING MACHINES
Dykem Co 277B	Buffalo Forge Co 57
LUDDICANTE	Wales Strippit, Inc *
Lubriplate Div., Fiske Bros 220	RETAINING RINGS
Standard Oil Co. (Indiana) *	Waldes Kohinoor, Inc *
(211111111)	
LUBRICATING SYSTEMS	SAWS
Farval Div 85	Armstrong-Blum Mfg. Co 253 Capewell Mfg. Co 212
Madison-Kipp Co *	Circular Tool Co., Inc 228
MILLING MACHINES	Circular 2001 Co., Inc. 111111 220
Cincinnati Milling Mch. Co 6-7	SCALES
Clausing div. Atlas Press Co 90	Fairbanks, Morse 176
Greaves Mch. Tool Co 246	SCREWS, ACTUATOR
Kearney & Trecker Corp *	Jerphak Bayless 277A
Marac Machinery Co *	Saginaw Steering Gear div *
Nichols, W. H. Co *	
Sundstrand Mch. Tool *	SHAPERS
HOTOR	Lapointe Mch. Co 183
MOTORS Brook Motor Corp. *	SHEARS
Brook Motor Corp * Reliance Electric & Engrg. Co. 32	Cincinnati Shaper Co 205
aronance Enterin & Engrg. Co. 32	Cleveland Crane & Engrg 64
OIL GROOVING MACHINE	
Wicaco Mch. Co *	SPEED REDUCERS
	Cleveland Worm & Gear Co *
OPTICAL TOOLING SYSTEMS	SPINDLES
Bruning, Charles Co *	Pope Mchry. Corp 254
Farrand Optical Co., Inc *	Standard Electrical Tool Co *
PLANERS	
American Waldrich Mfg.	SPRAYING EQUIPMENT, FLAME
Corp 92-93	Metallizing Engineering Co., Inc
Gray, G. A. Co	IIIC 201
Lapointe Mch. Co 183	STAMPINGS
20 1 4 1 3 F 1 M 1 G	

New METROsurf* surface roughness indicator

Laminated Shim Co.



Battery-powered or AC line operated, rugged AIL METROsurf, Type 180 measures surface finish directly in average microinches - quickly easily, accurately and economically ...Only \$495.00

For an informative 4-page folder, call your Cutler-Hammer Sales Engineer or write:



Circle this page number on card

Rockford Mch. Tool Co. 80-81

free literature guide-

Want more information? Below are listed the products described in this issue. Page number after company name refers to location of ad and number to be circled on cards for literature.

Creek Lakes Steel 94.95	THREADING EQUIPMENT Landis Machine Co.
	Reed Rolled Thread
	Sheffield Corp. (Gri
Timken Roller Bearing Co.,	Shemeid Corp. (Gr
	TOOL HOLDERS
Wheelock, Llovejoy & Co 204	Armstrong Bros. To
STEEL, TOOL & DIE	Metallurgical Produc
Allegheny-Ludlum Steel Corp. 265	Metanurgical Froduc
Crucible Steel Co 70-71	
Latrobe Steel Co *	TOOLS HAND WEEKING
*****	Williams, J. H. & Co
	williams, J. H. & Co
U. S. Steel, National Tube div. 255	TRANSFER MACHINES, MI
TABLES. PORTABLE ELEVATING	Barnes, W. F. & Joh
Hamilton Tool Co 264	Barnes Drill Co.
	Buhr Mch. Tool Co.
	Cross Co
	Davis & Thompson
	Greenlee Bros. & Co
Pratt & Whitney Co 58-59	Kearney & Trecker
TAPS & DIES	Kingsbury Mch. Too
	National Automatic
	Snyder Corp
	Great Lakes Steel

Landis Machine Co 2-3
Reed Rolled Thread Die Co 236
Sheffield Corp. (Grinders) 251
Shemeid Corp. (Grinders) 201
TOOL HOLDERS
Armstrong Bros. Tool Co 247
Metallurgical Products dept *
TOOLS, HAND-WRENCHES, ETC. Williams, J. H. & Co *
TRANSFER MACHINES, MULTI-UNIT
Barnes, W. F. & John Co *
Barnes Drill Co *
Buhr Mch. Tool Co 52-53
Cross Co 24-25
Davis & Thompson 272
Greenlee Bros. & Co
Kearney & Trecker Corp 233
Kingsbury Mch. Tool Corp *
National Automatic Tool Co. 34-35
Snyder Corp 179

VALVES	
Brown & Sharpe Mfg. Co	. 19
Hannifin Co	. *
Logansport Mch. Co	. 47
Ross Operating Valve Co	. 173
Schrader's A., Son	. 239
Skinner Valve div	55-56
Vickers Inc	. *

Vickers Inc
WELDING EQUIPMENT Federal Machine & Welder Co. * Precision Welder & Flexopress *
WELDMENTS Kirk & Blum Mfg. Co
ZINC New Jersey Zinc Co 195
* Advertisement appeared in pre-

Now! Finish parts up to 100 times faster at greatly reduced cost! The secret—



... the latest method for cleaning, descaling, deburring, grind-Ing, radiusing, fine-finishing, coloring and burnishing all metal and metal alloy parts, many suitable plastic and ceramic items . . . with the Pangborn Air-Cushioned Vibratory Finishing Machine!

The Pangborn Air-Cushioned Vibratory Finishing Machine gives you wider range of application, larger payloads and greatly-reduced time cycles resulting in tremendous savings. It easily handles parts too delicate and intricate to finish by other methods . . . works on shielded areas and interior surfaces . . . does coarser jobs faster with impressive cost reductions. Available in 11/2, 3, 6, 12 and 18 cu. ft. net capacity sizes. For details or to arrange demonstrations on your own parts, write Vibratory Finishing Division, PANGBORN COR-PORATION, 1200 Pangborn Blvd., Hagerstown, Maryland.

· Works up to 100 times faster than conventional methods; does more work better at lower cost

vious issue.

- Does work impossible to do by barrel finishing or other means
- Most compact vibrator on the market
- Air cushion support and suspension for automatic leveling and amplitude control supplants spring suspension systems subject to fatigue
- · Standard basic machines are equipped with mechanically variable speeds
- Floor vibration entirely eliminated, making possible (for the first time) second floor mounting



Find sources for more data, quickly, easily. Use MACHIN-ERY'S free literature guide on preceding pages. Advertisers in this issue are listed alphabetically by product. Page numbers following company names indicate both location of ad and number to be circled on cards for more data.

feel free to use cards below ... to obtain free literature on products advertised or described in this issue

- Circle <u>page</u> numbers of advertisements—if no page number appears on ad refer to advertisers' index or free literature guide.
- 2. Circle item numbers of new equipment, catalog descriptions.
- 3. Mail . . . we'll do the rest.

62	21	24	38	48	09	72	2 2	3	8	181	302	314	36	200	8 5	200	7.4	278		CK	1		512	524	536	548	999		581	593	8	617	83	641	553	09/9		:		:	:	:
																		Bu		BACK	١	30	119	523	535	547	629		989	265	100	919	87	979	22	M)			:		:	
	-	11	H	*	M	-	-	id	*	17	20	21	66	1 :	9 0	2 9	3 5	277		1	ı	Numbers																		-	:	:
:	10	SI	75	97	3	32	2	12	8	176	200	919	766	3 8	3	240	920	27		BAC	ı		51	23	S	546	N.		S	25	9	19	29	3	651			:				
	9	21	H	45	87	; 8	B	8	93	175	8	1 2		3 1	3	182		ZIID		INSIDE BACK	ı	Hem	509	22	533	35	557	269	578	200	602	614	96.9	8	93			:	:			STATE
2																		ZTTC		INS	١	-Circle	208	520	532	54	955	26.0	277	280	9	613	52	123	649			:				
2																		277B		N.	١		207	519	531	543	125	267	K26			613	Y CO	1 15	848			:				ZONE
																		277A 2		E FRONT	۱	Catalogues	90	518	953	542	72	200		200	200		1 6	1 19	3			•	•	:	:	
																		276 27		NSIDE	١	-													1 3				:			
5																		-		ī	١	Equipment,													3				:			
																		286		FRONT	١	_																			:	:
																		Z65		_	ı	For New	503						-		-				3 3		=			:	ESS	
																		264 275R		VERS:	١	7	288	2	200	200	8 8	3 5	296	200	28.	2 4			3 3		se prin		:	COMPANY	ADDRESS	:
	1	13	1 3	3 3	10	49	5	23	8	8 8		183	202	215	E	2	2	N K	279	00	I		102	613	200	3 5	3	3	196	970	2982	500	989	200	642		Pied	NAME	TITLE	8	8	CITY
	-		-	-		-	-	-	-		-	-		-	-		-							2 2	2 2	336	9 :	8		-	22	2 !		8:	1 20		0					
	19	1 7	3 3	4	3	3	72	1	6 3	R	181	2	214	226	238	20	262	274	218	BACK																1	2/60	:	:		:	:
	1	18	3 1	A	47	20	F	: 8	3 5	R	179	201	213	225	237	249	261	273	1112	1		bers				2 :									3 8							
	10	20	1	K	97	28	70	: 8	3 3	E ;	176	200	212	224	236	248	260	272	ZHE	SACE		Numb		ore	27	ā	96	33		573	291	3	6		8	3			:			:
NOTHING !	•		17	R	đ	57	8	3 8	100	2	175	199	211	223	215	247	259	112	ZIID	INSIDE BACK		Hem		8	221	2	250	201	3	218	28	200	1	929	2 2	3		:		:		STATE
Loge	0	0	07	R	7	38	6.8	3 8	8 3	26	13	191	210	222	234	246	200	270	ZIIC	SNI		Girde		200	225	1	24	200	200	E	28	3	613	8	5	3			•	:		:
CILCIO																		269	-	T.		l sen		201	519	531	2	18	201	216	288	3	612	77	929	9		:	:		:	ZONE
l																		268	-	2		Certalogues		8	218	23	242	254	266	575	287	262		3	9 5	-			:			
Agvertisements																		267 2		SIL				92	217	2	=	223	12	77	989	200	919	22	E34	2		:	:	:		:
ILAAR																			-	, ī		Fauipment.									-				8				:	:	:	:
101 A																		266		. 5		_		m m		-			_			_			_					:	:	
																		265			-	For New		3							-				25		Ŧ		:	:	RESS	:
																		284	4	. >		1	•	3	2	225	2	is	295	5	282	25	607	613	2	3	ne prin	WE.		COMPANY	CO. ADDRESS	:
	9	-		23	33	4	1	3 1	2	8	6	2	8	M	3	1 2	15	263	13	5	5			5	13	3	5	25	19	20	882	3	8	118	8	7	200	NAME	TITLE	ō	o	È



information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogs, data on new equipment described, and products advertised in this issue. In the Free Literature Guide immediately preceding these cards advertisers are listed by product group to facilitate location of advertisements on which you desire additional data and catalogs.

This card expires August 1, 1960

FIRST CLASS Permit No. 53 New York, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

93 WORTH STREET
NEW YORK 13, N.Y.

READERS' SERVICE DEPT.

This card expires August 1, 1960

FIRST CLASS Permit No. 53 New York, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

93 WORTH STREET
NEW YORK 13, N.Y.

READERS' SERVICE DEPT.





BOOKS LIKE THESE ARE RELIABLE TOOLS THAT CAN HELP YOU IN YOUR WORK!

MACHINERY'S HANDBOOK-16th Edition

A modern handbook is a necessity for A modern handbook is a necessity for every man who holds or hopes to hold a responsible job in the mechanical industries. This one is the "Bible" of them all. The latest edition of this world-renowned book combines all the valuable features of earlier editions with the most recent and useful machine-designing and machine-shop data obtainable. 192 pages added to 15th Edition. Over 500 completely new pages of reference data. 2104 Pages, Thumb Indexed. Indexed. \$11.00

THE USE OF HANDBOOK TABLES AND FORMULAS

A companion book for users of MA-CHINERY'S HANDBOOK which shows you how to get the most out of your Handbook. Examples, solutions and test questions show typical applica-tions of Handbook matter in both drafting-rooms and machine shops.

Special combination price with MACHINERY'S HAND BOOK, \$12.50

DIE-CASTING—2nd Edition

by Charles O. Herb Illustrations. 196 Illustrations. 310 \$5.00

MATHEMATICS AT WORK

by Holbrook L. Horton

100 pages of reviews of the fundamen-tals of arithmetic, algebra, geometry, trigonometry and logarithms. 482 pages of illustrated mechanical problems with step-by-step analyses and solutions. 146 pages of standard mathematical tables needed for all types of problem solving. 196 Illustrations. \$7.50

MACHINE TOOLS AT WORK

2nd Edition—by Cheries O. Herb Applications of standard and special machine tools, with data on speed, feed, production, etc. Covers turning, thread milling, thread grinding, drilling, tapping, boring, punching, riveting, planing, shaping, broaching, honing, superfinishing and much more. 584 pages, 434 illustrations.

GEAR DESIGN SIMPLIFIED

by Franklin D. Jones In chart form. Contains 110 gear-prob-lem charts and worked-out examples of gear design that show exactly how rules are applied in obtaining essential di-mensions, angles, or other values. 201 Drawings. 134 Pages. \$4.50

> More Books Described On Reverse Side

Order Them by Mail

INGENIOUS MECHANISMS FOR DESIGNERS AND INVENTORS

Volumes I and II by Franklin D. Jones. Volume III by Holbrook L. Horton

A comprehensive encyclopedia of mechanical movements unparalleled in scope and usefulness. Each volume is an independent treatise. Similar in size and general character, the contents are different. Tells what each mechanism consists of, how it operates, and the features which make it of special interest. Hundreds of illustrations.

Single Volume, \$6.50 Complete Set, \$16.00

ENGINEERED WORK MEASUREMENT

by D. W. Karger and F. H. Bayha

Comprehensive treatise on solving prob-lems of Method-Time Measurement (MTM) and Time and Motion Study, to establish efficient procedures. His-tory, fundamentals, mathematics, appli-cations, standards of MTM. Complete tables and official MTM working data card. 120 Illustrations. 630 Pages.

MANUAL OF GEAR DESIGN-3 Vols.

by Earle Buckinghan

by Earle Buckingham

Vol. I: mathematical tables, especially applicable to gear design. Vol. II: simple formulas and time-saving tables for solving spur and internal gear designing problems. Vol. III: formulas, charts and tables used in designing helical gears for parallel ahaft drives and "spiral" gears for non-parallel, non-intersecting shafts.

Complete Three-Volume Set, \$12.50 Any Single Volume, \$5.00

HELICAL SPRING TABLES

by John D. Gayer and Paul H. Stone, Jr. Index of over 6800 ready-designed com-pression and tension springs from which selections may be made with minimum calculation. 165 Pages.

DIE DESIGN AND DIEMAKING PRACTICE

3rd Edition-by Franklin D. Jones

Drawings and descriptions of a tremendous variety of dies and a vast amount of data to help you avoid ex-pensive mistakes and delays. A standard reference work in the metal-work-ing industries, used by some 40,000 diemakers, designers and tool engineers. 661 Illustrations. 1083 Pages.

DIMENSIONS AND TOLERANCES FOR MASS PRODUCTION

by Earle Buckingham

An analysis of the many problems of dimensioning with tolerances for mass production, showing their effect on tool design, gage design, production and inspection, and suggesting improved methods and practices to solve these problems. 179 Illustrations. 164 Pages. \$8.00

MACHINE TOOLS—What They Are and How They Work

by Herbert D. Hall and Herace E. Linsley

Introduction to fundamentals of mass Introduction to fundamentals of mass production. Covers each machine tool, how and where it functions, skills and organization that make modern mass production possible. A basic, thorough text on all phases of metalworking operations. 363 Illustrations. 488 Pages. \$5.50

APPLIED ELECTRICITY—4th Edition

Elementary text for first course in colleges and technical schools. Ideal for home study. Covers basic principles; contains diagrams, examples and problems. 387 Illustrations. 476 pages.

Use this handy order card to order your books. Mail it today postage-free.

> FIRST CLASS Permit No. 53 New York, N. Y.

BUSINESS REPLY

No Postage Stamp Necessary If Mailed in the United States

POSTAGE WILL BE PAID BY

THE INDUSTRIAL PRESS

93 WORTH STREET

NEW YORK 13, N. Y.

BOOK DEPT.



PUT THE FACTS AND FIGURES YOU NEED AT YOUR FINGERTIPS - WITH BOOKS!

ENGINEERING ENCYCLOPEDIA

by Franklin D. Jones

Condensed and practical information on 4500 subjects definitions of numerous 4300 subjects definitions of inherous terms used in engineering and manufacturing practice, the results of many costly and important tests and experiments. No single work will give you a broader knowledge with less reading effort. 206 Drawings. 1431 Pages.

NOW in ONE Volume, \$10.00

MACHINERY'S MATHEMATICAL TABLES

Edited by Holbrook L. Horton

This book has been serving mechanical engineers, machine designers, draftsmen, toolmakers, machinists and students for over 30 years! Now it is available in a greatly enlarged version, containing the authoritative, easy-to-use mathematical tabular information you need on the job. Designed for speed and utility. 254 pages.

\$3.75

PIPE AND TUBE BENDING

by Paul B. Schubert

Defines the six basic ways by which the bending of ferrous and non-ferrous pipe and tube may be accomplished. Descriptions of methods, applications, and features of the equipment available. 159 Illustrations. 183 Pages.

\$6.00

JIG AND FIXTURE DESIGN

by Franklin D. Jones

A thorough coverage of the principles of development and constructional details of jigs and fixtures. Designs show principles of construction that can be applied successfully to a variety of jig and fixture design problems. 345 Illustrations. 466 Pacet. trations. 406 Pages.

\$5.00

Order Them by Mail QUALITY CONTROL

New 4th Edition—by Nerbert L. Enrick Principles and techniques for everyday use. Shows manufacturers how to improve average quality of products and save money. Explains use of statistics for establishing tolerances which are applied to dimensions of components and assemblies as well as tolerances for non-dimensional quantities. Shows stepby-step improvement in long-run pro-

duction operations. 216 pages.

INSPECTION AND GAGING-2nd Ed.

by Clifford W. Kennedy
The specific functions of manual and automatic measuring devices and gages, the techniques of using them. Analyzes the methods and duties of the different types of inspectors. Ideal for use in the plant or as training course text. 345 Illustrations. 522 Pages.

\$9.00

HYDRAULIC AND PNEUMATIC POWER FOR PRODUCTION

by Harry L. Stewart Contains information on fluid-power circuits, types of equipment and oper-ational details useful to designers, buy-ers, installers and operators of hydraulic and pneumatic equipment. Describes step-by-step how air and oil equipment can be applied to the manual and auto-matic operations of all types of produc-tion machinery. 348 Illustrations. 416

SELLING TO INDUSTRY

by Bernard Lester
64 articles on how you can do a better
sales engineering job. Covers the problems encountered in selling industrial
products or services and discusses successful selling techniques. Case histories. 255 pages.

\$4.00

\$8.50

Use the postpaid card below to order the books you want. We will bill you later. Remember, you save postage charges on the books when you send payment in full with your order.

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y. Please send me the following books.

Bill me.	Bill company	Payment enclosed,	send books postpoli
Orders from	foreign countries,	except Canada, mu	t be accompanied
by payment	in full including	50¢ per book, paste	ige and handling.

COMPANY

COMPANY ADDRESS CITY STATE HOME ADDRESS

..... ZONE STATE

M/5/60

BETTER TOOL CRIBS

by William Raisalid

How to organize and operate an efficient tool crib with maximum benefits. How to avoid wasteful, haphazard methods of tool crib operation. Complete control systems based on the use of brass tool checks and triplicate tool charge slips are clearly described. 87 Illustrations. 152 Pages.

\$4.00

MACHINE SHOP TRAINING COURSE

by Franklin D. Janes

Contains 1124 pages of questions and answers, shop problems and solutions, blueprint reading charts. Illustrated by 572 drawings and photographs. For use as a textbook or for designers and production engineers who want the fundamentals of machine shop practice.

Two-Volume Set, \$9.00

Single Volume, \$5.50

INDUSTRIAL LUBRICATION PRACTICE

by Paul D. Hobson

Practical working manual covering motors, engines, turbines, compressors, refrigeration equipment, machine tools, pneumatic and hydraulic tools, and other industrial and marine equipment. Chapters on oil purification and recla-mation, use of cutting fluids, and storage preservation of machinery. 167 Illustrations. 534 Pages.

\$8.00

GEAR RATIOS FOR 4- 6- AND 8-GEAR COMBINATIONS

by Earle Buckingham

Simple method for determining sets of 4-, 6- and 8-change gears to meet pre-cision gear ratio requirements. Features tables of pairs of consecutive factorable numbers from 1000 to 40,000, their ratios and reciprocal ratios to use in making 4-, 6- and 8-gear combinations. 95 Pages.

DRAFTSMAN'S MATHEMATICAL MANUAL

by Franklin D. Jones

Draftsmen supplied, out of their daily experiences, this useful collection of classified problems and solutions. Contains principles of algebra, equations, problems involving unknown angles, solution of triangles to determine linear dimensions, calculation unknown dimensions, calculation unknown dimensions, calculation unknown dimensions, calculation unknown discussions. dimensions, calculating unknown diam-eters or radial dimensions, and general engineering and designing problems. 249 pages. \$3.50

> More Books Described On Reverse Side



Benefit? Turbo-Cut's longer chamfer distributes the load over more teeth and breaks up chips to minimize tap breakage. Turbo-Cut's longer chamfer makes tapping easier and cleaner on through holes, does a one-pass job on blind holes. Only Threadwell makes the genuine Turbo-Cut with the longer chamfer.

Also available in bottoming chamfer.

THREADWELL TAP & DIE CO. GREENFIELD, MASSACHUSETTS

Stocking Warehouses New York — Cleveland Detroit — Los Angeles — Greenfield, Mass.

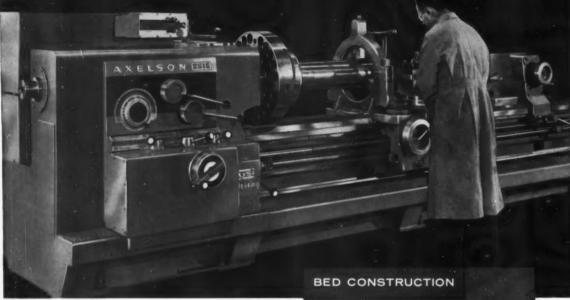




How you save with a Clearing-Axelson Blue chip lathe

number one of a series

costs you money

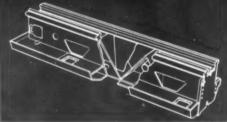


IF you don't have a Clearing-Axelson lathe

Roughing cuts, interrupted cuts, heavy cuts using ceramic and carbide tooling—these things can get an ordinary lathe vibrating like a tuning fork. Why worry about vibration? Simply because it results in costly tool breakage and lost time if your operators have to reduce speeds and feeds to a walk in order to get accuracy.

The all welded steel Clearing-Axelson Blue Chip has a bed which is 18 times stronger than a cast bed of the same size. No problem with vibration on this lathe. Operation is simpler, setups speedier, too.

Get the facts. Write for catalog or the name of your nearest dealer.



Internal bracing is carefully engineered to provide the greatest rigidity and accuracy. Side members are solid steel from ways to floor.

vsi Clearing

DIVISION OF U.S. INDUSTRIES, INC. 6499 W. 65th Street • Chicago 38, Illinois

Look for the CLEARING NAME on these products Machinical Process a Nudraulic Process a Terr.Pac O S.I. Process a Analysis Mrg. - Dict - Terr.Pac O S.I. Process a Analysis Mrg. - Dict - Terr.Pac Driv



















